THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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SENGHENYDD EXPLOSION.

TOWARDS the end of last week the Home Office issued a Blue Book containing the reports of Mr. Redmayne, H.M. Chief Inspector of Mines, and the assessors, Mr. Evan Williams (chairman of the South Wales and Monmouthshire Coalowners' Association) and Mr. Robert Smillie (president of the Miners' Federation of Great Britain), on the causes and circumstances attending the explosion which occurred at the Senghenydd Colliery last October. This disaster resulted in a loss of 440 lives, including the death of one man the day after the explosion, consequent upon a fall of stone whilst he was engaged in rescue operations.

In Mr. Redmayne's summary of his report he says :—

After carefully weighing the facts revealed by the evidence of the various witnesses and from my own personal investigations underground . . . . . I have come to the conclusion that there is strong probability of the explosion having originated on the Mafeking incline, and that it was preceded by an occurrence similar to that which took place further outbye in the Mafeking return in October, 1910, namely, by heavy falls liberating a large volume of gas. These heavy falls exposed seams of coal and beds of hard rock, and an outburst of gas may have come away at one of them. The only apparent means of ignition would be sparks from the *electric signalling apparatus*, or from rocks brought down from the fall, and we know that explosions have been originated by both these causes. The only other possible means of ignition were safety lamps or matches. The difficulty in regard to the former is that no lamp was found in the place, and even were a broken lamp found under a fall, there would be the inference that it may have been broken by the fall. There were, however, lamps lower down the heading, but there is no evidence pointing to any of them having been the igniting cause of the explosion. In respect of matches. . . . a rigorous search of the persons descending the mine was being carried out daily, and the possibility of a match being the igniting cause is, in my opinion, remote.

The italics are ours, and in view of the fact that we have on previous occasions expressed the opinion that the signalling apparatus did not originate the explosion, the expression of opinion by Mr. Redmayne to the opposite effect is a little disconcerting; frankly, we are both surprised and disappointed, as the bulk of the evidence given at the inquiry seemed to show that the explosion originated at an open lamp at the lamp station. We do not by any means wish to assert that sparks from signalling wires will not ignite mine gas—far from it—as experiments have been carried out which prove that it will do so, but in this particular case we maintain that this was not the cause. The view expressed in Mr. Redmayne's report is really the theory of Dr. Atkinson, H.M. Divisional Inspector for South Wales, who said :—

If the explosion originated on Mafeking Incline, the question is how it was caused. There were very heavy falls of road, exposing seams of coal and beds of hard rock, and an outburst of gas may have come away with one of these falls. If this occurred, the only apparent means of ignition would be by a spark from the electric signal wires or sparks from rocks brought down by the fall.

This theory is not advanced as a positive conclusion. Neither sparks from signal wires nor sparks from falling stones are very probable means of ignition, although I have no doubt that some explosions have been initiated by both these causes; and if the explosion commenced on Mafeking Incline, these are the only means of ignition I can suggest.

Although the experiments with electric signal wires did not prove that sparks at the voltage said to be in use on the incline would ignite firedamp, the margin is too small to convince me that it is impossible.

Mr. Redmayne then somewhat adversely criticises "the rescue operations," "the state of the mine prior to

the explosion," "fireman's reports and fireman's districts," and alleges several breaches of the Mines Act, 1911, and regulations under the Act, of which we may have something to say on another occasion when we deal more fully with the report, but Mr. Evan Williams, who presents a somewhat lengthy report, says :—"I regret I am unable to subscribe to Mr. Redmayne's report owing to my differing from him in greater or less degree upon several material points," and on the question as to the origin of the explosion he says :—

> The only two places suggested as possible seats of origin of the explosion are the Mafeking hard heading and that portion of the Main Lancaster Level between the No. 1 North and the lamp station. Wherever it took place, there must have been an outburst of gas which came in contact with a flame, large, like that of a lamp, or small such as a spark, but containing sufficient heat energy to ignite it, bringing about a gas explosion.
>
> To my mind the evidence is quite conclusive that the characteristics of the installation were such that no spark capable of igniting gas could have been produced. There is another point which seems to me to bear upon this question, as far as the signalling apparatus . . . is concerned. From my own observations underground, as well as from the evidence, I am satisfied that the positions of the journeys at the top and bottom of the incline were such that *no signalling could have been going on* when the explosion occurred.

In conclusion, Mr. Williams says :—

> Believing as I do that the explosion was caused by an open lamp in the lamp cabin, I think that the new lesson to be learnt from this disaster is that in mines which are dry and dusty and liable to . . . . . outbursts of gas, no open light and no unlocking or opening of safety lamps should be permitted underground.

In assigning the value of a report one must have regard to the position and experience of the author, and in Mr. Williams we have an experienced mining engineer, not only conversant with all the local difficulties and conditions affecting that particular coalfield, but who has also the responsibility of carrying on mining operations from the financial point of view, and whose interest in mining is, therefore, more than merely academical; for these reasons we are inclined to regard Mr. Williams's views as being much more reasonable and practical.

With regard to Mr. Smillie's report, he, in the main, agrees with Mr. Redmayne, but disagrees with both Mr. Redmayne and Mr. Williams on the question of reversal of the air current, supports the evidence of a witness named Thornton, a collier, who evidently made some rash statements, says the hours of the fan enginemen—who, as a rule, have nothing whatever to do—were too long, and asserts that the districts in charge of the fireman were too large. It is really very difficult to see how Mr. Smillie's position as an assessor on an important technical inquiry like this is justified.

Returning for the moment to signalling with bare wires, we may point out that this system was used in mines all over the country for years before the general introduction of electricity for lighting and power purposes, and it seems strange that its liability to cause an explosion has never been seriously thought of until now; even with the experiments carried out during this inquiry, the question is still so undecided that Mr. Williams suggests "that the Government should at once carry out an exhaustive series of tests with a view to determining what may and may not be permitted to be used in mines liable to outbursts of gas," and "this system of electric signalling with bare wires possesses, in its simplicity, ease and quickness of manipulation, and its reliability, so many practical advantages over all others, that its prohibition would, I am convinced, lead to a big increase of accidents upon haulage roads, and the objection to visible sparks incapable of igniting gas is sentimental only."

We agree with Mr. Williams, and trust that the outcome of this inquiry will not be some Home Office panic regulation relating to electrical signalling in mines with bare wires, but we certainly think that it would be to the advantage of both owners and workmen if the oil lamp could be dispensed with as far as possible, and electric lamps substituted in their place for carrying on the work of the mine, limiting the oil safety lamps to officials whose duty it is to test for gas. Then we may hear less of electricity being the cause of explosions, for the very simple reason that the likeliest cause of all explosions is the so-called "safety" lamp.

On Travelling at Home and Abroad.

A short time ago some correspondence appeared in these pages concerning the place filled by the commercial traveller in modern industry. The discussion was started by one who thought that travellers of the usual kind were a needless burden in the case of so complex and specialised an industry as electrical engineering; the writer seemed to see merely the need for technical men and principals, and was shocked at the cost of competing firms keeping innumerable travellers on the run after contracts that were known to be going. But, interesting as all this may be for the purposes of discussion, it weighs but little in the estimation of firms engaged in practical business, who know well enough that the race is not to him who falls out of the running, and that out of sight may also mean out of mind. Correspondence, advertising, periodical visits of principals, all of these are essential means of keeping one's business up to that standard of efficiency and in that state of activity that will maintain a desirable reputation. Firms have we known who fell into disfavour because they failed to attend properly to correspondence; others through a persistent non-advertising fit or policy have led to questionings as to whether they were still in business; and yet others have stood far lower in the industrial scale than they need have done because their principals or managers have not felt inclined to leave things to associates or subordinates the while they themselves were handshaking with possible clients or studying the markets of the world. But not all of these means combined can enable average businesses to dispense with the work of the plodding commercial traveller. We know that he is often looked down upon, but often enough he "makes good" better than the scorner, and he is an essential part of our industry. If he be entirely non-electrical he has many pitfalls awaiting both himself and his firm, but we do not believe that in the electrical industry to-day there are very many men of this stamp "on the road." The opportunities for securing enough electrical knowledge to make him more "fit" as an electrical commercial traveller are varied and numerous, and he does well to avail himself of them sufficiently to over-pass that line where "a little learning is a dangerous thing." But the man who has set out at the beginning to secure an electrical training has, in many cases, found it attractive to turn his thoughts to commerce and industry, and he requires to add business knowledge and ability to his technical attainments at a certain stage, just as the "commercial" must, to some extent, qualify electrically in order to reach the standard of efficiency required for securing a successful career.

Sir Horace Marshall, at the annual dinner of the Commercial Travellers' Benevolent Institution held last week, said a good word for the class of men concerned in that organisation. "The place of the commercial traveller in the great scheme of commerce was the place of the shuttle in the loom, whose journeys to and fro built up the useful fabric. He was indispensable. 'The Romance of Business' was a common phrase to-day; but that romance did not take the stage unless the commercial traveller was busy behind the scenes." "It was certain that most people who were enjoying success in commercial life had found a commercial traveller necessary to that success."—(*Times.*) Of course results vary largely according to your man, personality and courteous and timely persistency counting for a great deal. Many great commercial schemes have been planned around one man because of his sterling qualities; but for the man there would have been no scheme.

In these days, when the electrical industry is so largely concerned with foreign trade connections, the dispatch of highly-qualified ambassadors is a matter of supreme importance. A few years ago, as a result of a newly-aroused interest in foreign trade, for which we were in some part responsible, many leaders in British electrical and engineering industries saw the wisdom of personally visiting Colonial and foreign markets. Some of them came back laden like Caleb and Joshua with the grapes, and thought the risks of meeting giants, in the shape of international commercial rivals, should not suffice to lead us to limit our efforts to home.

It occurs to us that the time is now ripe for more of these visits in the interests of British electrical trade;

every experienced foreign trader knows the importance of re-visiting a market with reasonable frequency in order to keep his memory green. Some of our works are chock-a-block with work for a year or two to come, but others are not, and whether there is or is not any reason to fear a slump in general trade we do well to be active and alert in those parts of the world where business is going. In this connection we would draw our readers' attention to Blue Book Cd. 7,031 [9d.], just issued by the Government Stationery Office, wherein are given particulars of the regulations in force in the various Colonial and foreign countries with regard to British commercial travellers. To every firm doing business abroad and sending out travellers the information given herein is of great reference value.

Wanted: A Sign.

The old saying about undue familiarity breeding contempt has been again and again exemplified among workers engaged in the neighbourhood of live electrical apparatus. The word "Danger," and the representation of a skull and cross bones, answer for a time, but the emphasis which they bring to the mind when new does not continue; sometimes, unfortunately, a new meaning seems to be given to the warning after there has been an accident, but reports of inquests and inquiries show how easy it is to become heedless of dangerous surroundings, to neglect facilities provided for one's protection, and to run unnecessary risks due, probably, to absent-mindedness, thoughtlessness, or a prepossession with the piece of work in hand. It matters little what regulations we may impose or what warnings or signs we display, these weaknesses like the poor, will be always with us, but that does not relieve us of the duty of conceiving and adopting the most reasonable and efficient measures for ensuring safety. We have been asked by a correspondent who is thoroughly conversant with the conditions obtaining in electrically-equipped collieries and industrial works whether we can suggest other signs or mottoes besides the skull and bones and the word "Danger." It occurs to us that a number of our readers might be able to offer from their practical experience suggestions which would be of value. What is wanted is something which, while it will not put the worker into a morbid frame of mind, will occasionally give him a shudder or a cold shiver down his back—to how many men does the skull and cross-bones do that after a few days' familiarity?

We have no doubt that many other warning mottoes and signs are in use, and while some of them may possess a value more local than general, it would be interesting to hear of them and to record the experiences of workers who have observed their effects either upon themselves or upon their *confrères*.

Rubber.

The rubber auctions last week, at which about 1,350 tons of plantation grades were offered for sale, opened with a firm tone, and the best sorts marked an advance during the earlier proceedings, finest crepes showing an advance of 2d. to 2½d. a lb., and smoked sheets a gain of 1½d. to 2d. a lb., with a pretty brisk demand, but on the second and third days there was a very sharp reaction, trade buying falling off notably, and the easier tone was assisted by reports as to impending very large arrivals. As a result the greater part of the initial advance was lost as regards fine crepes, which sold down to 2s. 6½d. a lb., compared with 2s. 10¾d. on April 21st, closing at about 2s. 7¼d. There has lately been some scarcity of the fine crepe descriptions, and, in consequence, prices of this variety have been exceptionally well maintained at an unusually good premium, the production of this sort having been comparatively neglected in favour of smoked sheets. Something like a moderate degree of scarcity thus became developed in the former, and there had been some speculative selling a time ago, which sales had eventually to be covered, all of which helped the price upwards. The quantities of plantation rubber generally coming to hand have been liberal, but have also been very well taken up by the trade, while, as a rule, consumers have not been buying in anticipation of requirements, limiting their purchases to the supply of near needs. Their unfortunate experiences of the boom year have effectually stifled any disposition to buy largely for forward delivery, unless there are clear indications that things are improving as regards trade, and this cannot be said to be the case at the present time. At present there is a pretty good opinion held as to the prospects, especially from the point of view of the cheaper producers, and those which are capitalised at a reasonable figure per acre.

A correspondent of the *Times* recently wrote at length upon this matter, asserting that "it is somewhat curious that there is still a wide-spread belief in the danger of the production of plantation rubber outstripping consumers' demands. There seems to be in reality no such danger, at least until the present planted area has been largely increased, and the increased area brought into bearing." It is probably true that no extended planting programmes are likely to be formulated for a good while to come, and meantime there is a steady reduction in the tonnage of wild rubber being harvested. Last year, certainly, the consumption of rubber generally was in excess of the output, but in considering the position at present it must be remembered that this year trade in all directions shows evidences of reaction, and this introduces a new factor which is bound to tell, though how far it is impossible at present to see.

Official information is to the effect that the exports of plantation rubber from the Federated Malay States during March were 2,418 tons, compared with 2,364 tons in February, and 2,542 tons in January, the total for the three months 7,324 tons, comparing with 6,525 tons for 1913, and 3,809 tons for 1912. The exports for February from the Amazon basin were 5,120 tons, against 4,500 tons in February, 1913. It is a matter of considerable interest to users of rubber to know that the Rubber Research Committee of Ceylon, in co-operation with the Ceylon Department of Agriculture, have made arrangements with the Imperial Institute to conduct a series of investigations which are expected to afford definite knowledge as to the effect of different methods of preparation on the quality of plantation rubber. With this purpose in view, a laboratory has been installed at the Imperial Institute, and the work taken in hand in a thorough way. A further rather interesting matter is that the question of the standardisation of rubber is said to have been solved by the forwarding to Great Britain of latex direct from the trees for coagulation and treatment generally, an evenness of grade and quality being thereby procured, so it is claimed, which are unattainable by any other process.

Some Rules for Arbitrators.

At the conclusion of a paper on "The Arbitration Clause," which he read before the Society of Architects on April 16th, Mr. W. Valentine Ball enumerated a few maxims which, he thought, might be of practical use. They were embodied in a series of "Don'ts," which we venture to reproduce, as they may be of service as reminders to those of our readers who are called upon to act as arbitrators:—

Don't have lunch with one party only during the course of an arbitration.

Don't have any communication, written or verbal, with either party without the knowledge of the other.

Don't forget that patience is a branch of justice.

Don't blame the advocate for being too long-winded, it is a way he has; and very often counsel gets it hot from his client if he does not follow every point to the bitter end.

Don't forget to procure a Testament wherewith to swear the witnesses.

Don't talk more than is absolutely necessary.

Don't place much reliance upon the evidence of a witness who is too glib.

Don't forget that you have power to state a case on a point of law for the opinion of the Court.

Don't forget the important item of costs when making your award. Very often the costs incurred far exceed the sum in dispute.

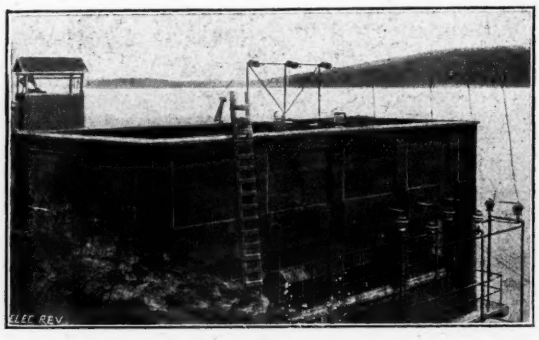
Don't divulge to either party the effect of your award unless, and until, your fees are paid in full.

Very often the "lay" arbitrator is wholly unaccustomed to the forms of law, and, in his ignorance, is apt to pay no heed to the most elementary rules by which a legal tribunal is unconsciously bound. No doubt it is one of the objects of a reference to arbitration to avoid technicality as much as possible; but the arbitrator should never allow his "Court" to become quite so informal as that of the proverbial "Cadi under the palm tree."

THE BAMBERTON CEMENT WORKS.

A most interesting cement-making plant is that which has recently been put to work on the Saanich Inlet, about 20 miles from the City of Victoria, in Vancouver Island, B.C. The constructional work has been carried out entirely by the engineering department of the Associated Portland Cement Manufacturers, Ltd., whose headquarters are at Gravesend, England, for the Associated Cement Co. (Canada), Ltd. The works are situated in a hitherto undeveloped part of Vancouver Island, and it was consequently necessary to erect a village for the accommodation of the staff and workmen.

It must be satisfactory to British engineers to know that throughout the new works, with quite minor exceptions, British plant has been employed; it is also of interest to note that with the exception of one or two steam pumps, electricity is used for power and lighting purposes throughout; other interesting features are the use of oil fuel for firing the rotary kilns, and of "Cascade" motors without slip-rings throughout for electrical driving.

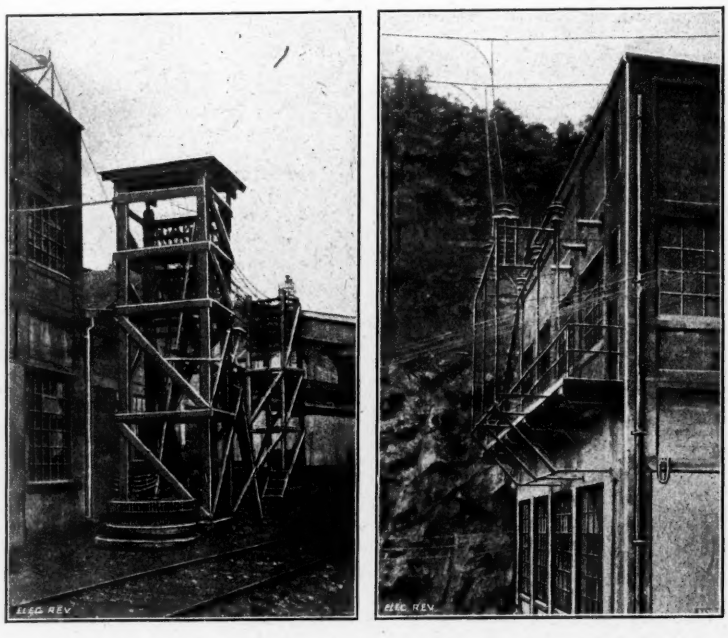


Exterior of Sub-Station, showing 60,000-volt Leading-in Wires.

A brief outline of the processes employed will be of interest. The limestone, which is quarried close to the works, is hauled up an incline and tipped direct into a No. 8 Gates crusher, from which it passes through two No. 5 crushers, which reduce it to a maximum size of about 2 in., and is then taken on belt conveyors to the limestone hoppers.

The shale is quarried some five miles further up the Saanich Inlet, and is brought to the works in scows, being unloaded into a No. 5 Gates crusher, from which it is elevated and conveyed to a series of shale hoppers, alongside those for the limestone. The two sets of hoppers contain all the raw materials for the plant.

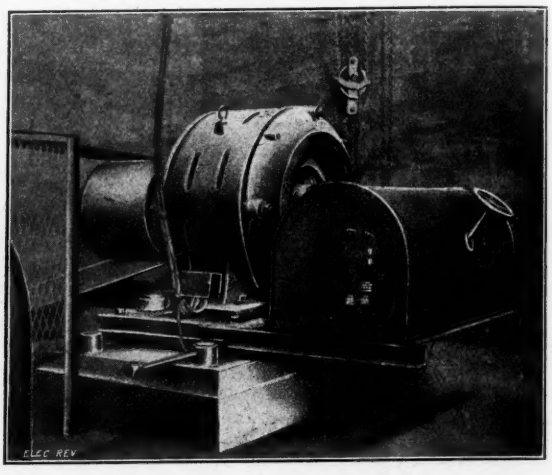
From them the raw materials are fed direct into the wet grinding plant, consisting of five ball mills and five tube mills, each unit being driven by a 160-H.P. motor; the resulting slurry is pumped through a 6-in. main to four mixing tanks, which together hold a week's supply of material, and from them it is pumped direct into the rotary kilns.



Works Sub-Station, showing L.T. Transmission Tower and Platform for Charging Lightning Arresters, H.T. side.

The burning is carried out by means of oil, which is pumped direct from the tank steamer into four storage tanks, each holding 15,000 barrels, whence it is discharged as required into a small tank close to the kilns. It is delivered to the kilns by steam pumps, and before entering the burners is passed through tubular steam heaters. The blast to the burners is supplied by Roots blowers, driven by 60-H.P. motors.

The red-hot clinker from the kilns passes into rotary coolers, giving up its heat to the air blast for the kilns; it is then discharged into a ferro-concrete silo of large capacity, immediately over the dry grinding plant, which consists of four ball mills and four tube mills, each of these again being driven by one 160-H.P. motor. The cement is afterwards passed through coolers, which reduce it to atmospheric temperature, and delivered by worm conveyors to the silos, from which it is transferred to the packing plant for delivery.



160-H.P. "Cascade" Motor driving Tube Mill in Dry Grinding Mill.

It will be noticed that from the point where the slurry enters the kilns to that at which the cement is extracted from the silo, the process is entirely on the gravity principle. This is quite unusual for a cement plant, and has the advantage of eliminating all elevators.

The arrangement was, of course, possible owing to the nature of the site.

The cement is packed with Bates's patent machines, driven by 15-H.P. motors, and the bags are delivered direct from the packing machines to the ship by belt conveyors.

Water for the plant is obtained from reservoirs constructed on the high ground above the works, but in order to reduce the draw on this source during the dry season, which lasts about four months, two centrifugal pumps have been erected in a chamber on the shore for delivering salt water when necessary.

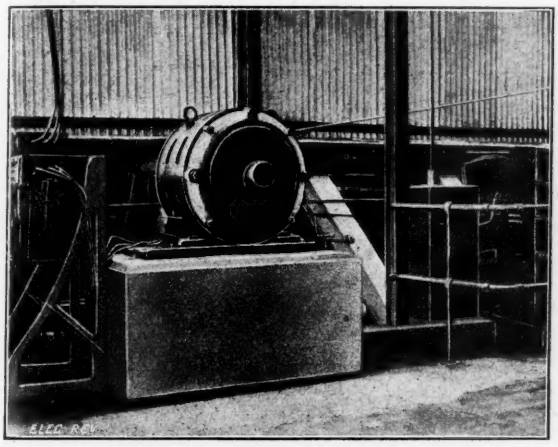
The situation of the works was determined by the adjacent supply of almost pure limestone which could be handled by gravity. Heavy reinforced concrete construction was

employed in the buildings ; the cement silo has 28 bins and measures 70 ft. × 120 ft. × 70 ft. high.

The whole of the electrical energy required is purchased from the Jordan River hydro-electric plant of the B.C. Electric Railway Co., being delivered as three-phase current at 60 cycles, over its 60,000-volt lines to a sub-station at the works containing four 1,000-KW. transformers, wound for 34,600/575 volts, one of which is held in reserve.

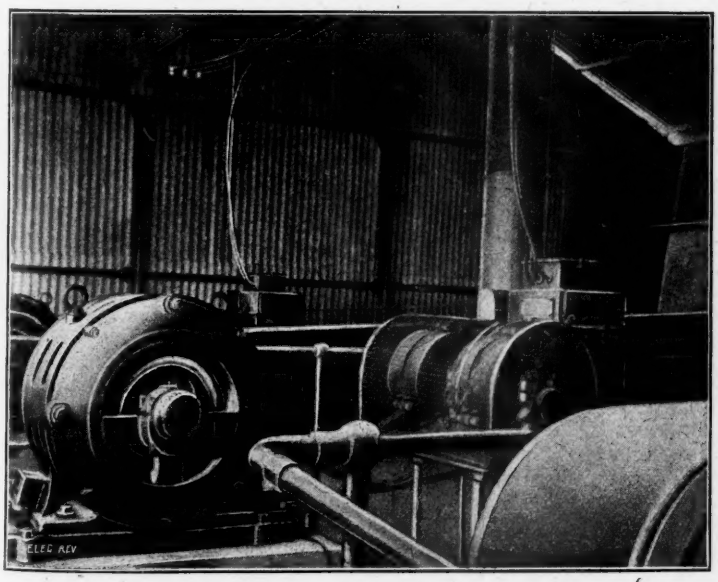
These transformers deliver energy at 550 volts between phases to the works switchboard, for motor supply ; a further reduction in pressure to 110 volts single-phase is made for lighting purposes.

The main switchboard was supplied by Messrs. Reyrolle and Co., and is of their well-known ironclad type ; it includes



60-H.P. Cascade Motor Driving Rotary Kiln.

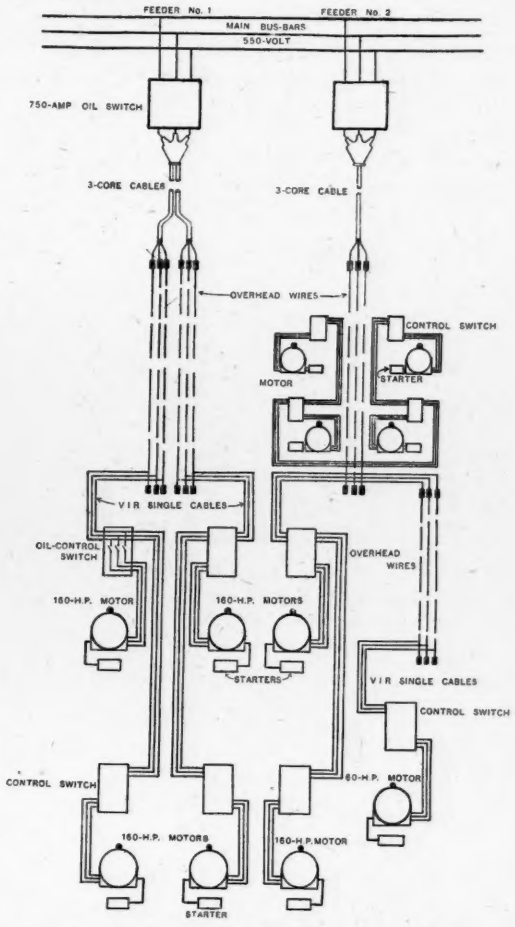
a series of panels, the first of which is equipped with the supply company's graphic-recording and integrating wattmeters for 3,000 KW. ; a second contains the main three-pole oil switch for 3,500 amperes per phase, fitted with overload trips on two phases and no-voltage release ; the third and fourth are the Cement Co.'s meter panels, the third being equipped with a Westinghouse graphic-recording wattmeter for unbalanced loads up to 3,000 KW., with a 31 days' chart, and a Chamberlain & Hookham integrating wattmeter for up to 3,000 KW. and 1 million units, while the fourth contains the main voltmeter and phase ammeters,



60-H.P. Motor Driving Roots Blower.

a 3,000-KW. indicating wattmeter, also power factor, leakage and frequency indicators.

There are also 10 feeder panels, each equipped with a three-pole oil switch fitted with overload trips in two phases and an induction type ammeter. All the trip coils are fitted with adjustable time limits. One of the feeder panels is a spare and another feeds the transformers for the works and village lighting.



Typical Feeder Layouts, Bamberton Works.

The motors supplied number 71 in all, including spares, and are of the Sandycroft Co.'s "Cascade" type throughout.

Of the above number, 20, including one spare, are of 160 H.P. each ; one drives three Gates limestone crushers, 10 drive ball and tube mills for wet grinding, and eight similar mills employed in dry grinding.

These machines are of the three-bearing open frame type, without slip rings, and will give twice full-load torque at starting with 2·1 times full-load current. The normal speed is 590 R.P.M., efficiency on full load 91·5 per cent., and power factor ·90.

The motors operate in conjunction with worm-geared liquid starters of the Woolliscroft pattern, which are electrically interlocked with the motor controllers through the no-volt release coils of the latter, in such a way that the handle of the starter must be in the "off" position before the control switch can be closed. The controllers are pedestal type ironclad three-phase oil switches ; they are of the loose-handle type, each provided with an ammeter, and fitted with two overload trip coils and a no-volt release.

There are also 10 60-H.P. cascade motors of the open two-bearing type, speed 575 R.P.M., with a full load efficiency of 87 per cent. and power factor ·87 ; these are driving a shale crusher, two air compressors, a haulage, three blowers and two rotary kilns, one motor being held in reserve.

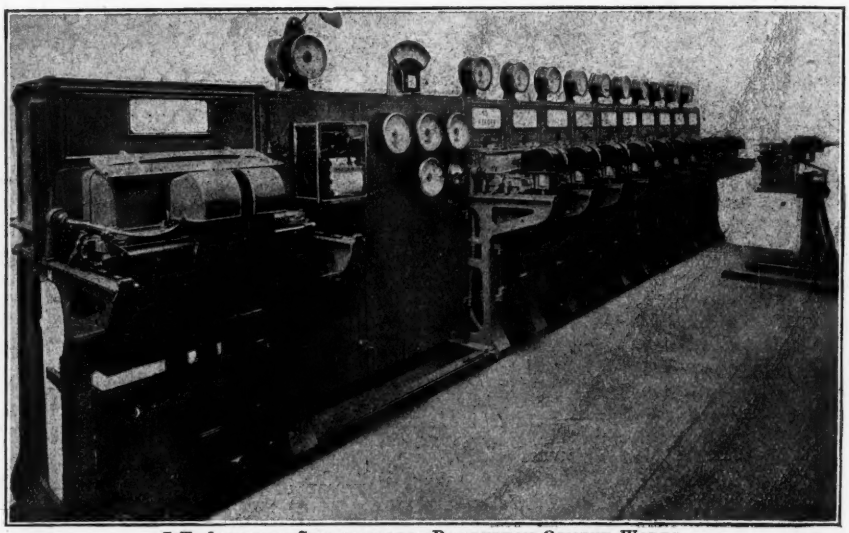
Special metallic starters, combined and interlocked with

controllers of the drum type, to give a considerable speed range, are fitted to the kiln motors, while in the case of the haulage a reversible drum type controller is fitted.

In addition to the above, there are 34 15-H.P. cascade motors, for driving mixers, slurry pumps and conveyors, and the automatic packing plant, the mixer motors being worked with metallic starters, giving two speed stops. These motors have a normal full-load speed of 575 R.P.M., and efficiency of 84·5 per cent. In addition to the above, there are a few small motors, but it will be noticed that three standard sizes of motor have been adopted practically throughout, this with a view to reducing spares to the smallest amount possible. Although large motors are employed, there is not a slip-ring in the place; with unimportant exceptions the motors all drive through belting. Five of the feeder panels are equipped with 750-ampere oil switches, and the other five with similar 400-ampere switches.

The switch panels are coupled up by three-core cables (mostly 37/12s.), to the terminals of the bare overhead wiring used in the works, the motor-control panels being connected to the latter by three single V.I.R. cables.

One of the feeders supplies a transformer sub-station, equipped with one 60-KW. and one 30-KW. transformer for supplying the works lighting, also two 30-KW. transformers for the village supply, the lighting being on 110 volts. The transformers were supplied by the British Electric Transformer Co., and the sub-station switchgear by Messrs. Ferranti.



L.T. Ironclad Switchboard, Bamberton Cement Works.

All the smaller accessories used were in accordance with the American Fire Underwriters' requirements, the switches and ceiling roses having special clamping-type terminals, the lampholders and lamps being of the Edison screw type, fitted with special Canadian screw caps, and the cluster fittings, &c., being all screwed to the standard American pipe thread, so as to be, as far as possible, interchangeable with the apparatus used in Canada.

The whole of the plant has been constructed under the supervision of Mr. H. K. G. Bamber, the designs and specifications being prepared under Mr. C. Percy Taylor, chief engineer to the Associated Portland Cement Manufacturers (1900), Ltd.; Mr. Henry Anderson, formerly engineer at the company's Swanscombe Works, acted as resident engineer and is now in charge of the works.

THE GOLDSCHMIDT TONE-WHEEL DETECTOR FOR WIRELESS TELEGRAPHY.

By S. M. POWELL.

There is little difficulty in building a D.C. galvanometer to measure, say, one-hundredth of a microampere, since a reasonable torque can be obtained, despite the minuteness of the current, by employing a very powerful magnetic field. This method is inapplicable to the measurement of the feeble currents received in wireless antennæ, owing to the practical impossibility of establishing a powerful alternating field of, say, 30 kilocycles frequency and maintaining synchronism between this and the current to be measured. A similar difficulty arises in electrostatic instruments.

Fessenden was the first to employ a high frequency generated at the receiving station for purposes of reception. In his heterodyne system, he uses a current the frequency of which is a few per cent. higher or lower than that of the currents to be received; for example, if the "arriving" frequency F_1 be 50 kilocycles, F_2 may be 49 kilocycles per second. By exciting galvanometer magnets or the plates of a static instrument by the F_2 current and the moving system by the F_1 current, the moving system is vibrated at 1 kilocycle per second, and such oscillations must be recorded oscillographically. By substituting an electrostatic or electrodynamic telephone for the galvanometer a tone of 1 kilocycle per second frequency would be heard were the telephone of sufficient delicacy. Actually, Fessenden employs a rectifying detector, and mixes the undamped 50-kilocycle current received with the 49-kilocycle current generated at the receiving station. Beats are thus obtained which are audible as a 1-kilocycle frequency note in an ordinary telephone.

Goldschmidt has sought to solve the problem of reception by using an asynchronous frequency transformer, and has experimented with his high-frequency generator in this connection (see *E.T.Z.*, 1911, page 54; 1914, page 93). By reversing the action of this machine, feeding it with high-frequency current, and running it asynchronously, low-frequency A.C. becomes available (at the terminals to which D.C. was formerly supplied), and the frequency of this current depends only on the degree of asynchronism. Remanent magnetism produces a continuous noise in the receiving telephone in such a case, but there is a clear underlying tone, and it should be possible to eliminate the effect of remanent magnetism by suitable opposite excitation.

A better and simpler alternator is, however, given by a modification of Leblanc's A.C.-D.C. commutator (which is usually supplied from transformer tappings, and then rectifies by simple commutation). In wireless work, this commutator can be used without the least trace of that sparking trouble which limits its application in heavy current engineering. To adapt it to frequencies reckoned in kilocycles, the Leblanc commutator is reduced to the form of a toothed wheel, and instead of actually commutating the high-frequency current, it makes contact only during alternate half waves (thus acting on the vibrating-rectifier principle). It is not then difficult to obtain the desired frequency of interruption—for example, 40 kilocycles per second requires a peripheral speed of 40 m. per second (8,000 ft. per minute), assuming 1 mm. tooth pitch on the "tone wheel" as the apparatus is now called. Since it is practically impossible to rotate the wheel in exact synchronism, the frequency of interruption is deliberately made 39 or 41 kcy. in the case of 40-kcy. current. The "commutated" current has then the wave form shown in fig. 1, *i.e.*, a "toothed" A.C. of 1 kcy. frequency. It suffices to rotate the tone wheel at any uneven fraction of the synchronous speed. On supplying A.C. of any frequency to the brushes and running the wheel up from rest, the tone heard in the receiver runs through the whole scale. A sustained twittering is heard up to about one-third synchronous speed; then a long pause

ensues till synchronism is approached. At even fractions of synchronous speed, the tone phenomenon arises if the brushes are wide. In order that the periods of contact and interruption may be equal, $\beta + 2b = a - 2b$, where b = brush width ; β = tooth width ; and a = gap width. If b is too great, the secondary current wave is as in fig 2 ; but if the above equation is satisfied, the secondary current is as in fig. 3, *i.e.*, it has no D.C. component at half synchronous speed.

As now built by the C. Lorenz A.G., the Goldschmidt tone wheel is direct coupled to an electric motor fitted with an automatic centrifugal contact speed regulator and eddy-current brake as artificial load. The brushes used are of copper wire or sheet embedded in insulating material, which

FIG. 1.

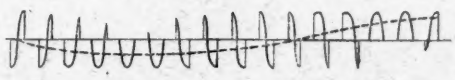


FIG. 2.

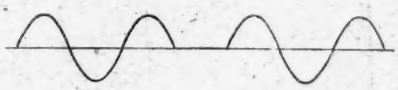
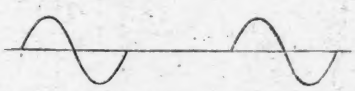


FIG. 3.



wears with the copper (at about 0·5 mm. per hour), and damps vibration. To eliminate continuous noise due to creep-leakage from the motor side of the set, current is led through the tone wheel as near as possible to the make and break brushes, and very liberal insulation is provided.

Experience so far obtained shows that the tone wheel is at least as sensitive as any other type of detector. It has given satisfactory results in trans-Atlantic service between Eilvese and Tuckerton. Its chief advantages may be thus summarised :—(1) Damped waves (from spark stations) are not received as a pure tone ; (2) signals received from stations with slightly different wave lengths are audible as very different tones, since the latter depend on the differences between the frequencies received and that of the tone wheel ; (3) the tones received are easily distinguished from atmospherics ; (4) every telephone responds best to a certain frequency, and the latter can now be secured by varying the tone-wheel frequency. The loudness of reception can be thus increased approximately in the ratio 1 : 10. If a reflecting galvanometer be used in conjunction with a tone wheel, records may be obtained in ordinary Morse characters. The frequency of mirror vibration is far too high to produce visible effects on the recording strip, hence the black line produced when the mirror is at rest is interrupted by white dashes or dots when the mirror is vibrating.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Joint-Box Compound.

A report made in August last by the National Physical Laboratory on "Trinidite" joint-box compound, supplied by the DUSSEK BITUMEN CO., of Deptford, S.E, to meet Admiralty requirements, shows that a 6-in. cube of the material placed in a metal box partially immersed in boiling water for half an hour did not alter by as much as 1 in. a side through softening. Tested for di-electric strength, the material, cold, withstood a pressure of 2,000 volts between electrodes $\frac{3}{16}$ in. apart, and a box containing the compound immersed in boiling water for half an hour withstood the same pressure for this period. Tested for absorption of water, two 2-in. cubes immersed in distilled and sea water for a week increased in weight by ·016 per cent. and ·024 per cent. respectively, the specification calling for not more than ·5 per cent.

A Faraday House test showed that an average thickness of the compound of ·076 cm. withstood 13,300 volts (50 cycles, A.C.) for half an hour without the insulation breaking down.

Soutterware Heating Apparatus.

In their newly equipped showrooms at 5, Chapel Walks, Cross Street, Manchester, MESSRS. ECKSTEIN, HEAP & CO, LTD., exhibit a line of "Soutterware" electric kettles, and other water heaters, toasters, &c., the firm being agents for Messrs. Wm. Soutter and Sons, Ltd., of Birmingham. In these kettles, of which we illustrate

FIG. 1.—"SOUTTERWARE" ELECTRIC KETTLE.

an example ("The Indian"), made in either brass or nickel plate, the unit is so arranged as to be entirely surrounded by water. The better class kettles are provided with two heats and are all tested to boil two pints of water in 13 minutes. In the event of failure the unit is easily replaced, but strength of construction has been made a special feature. We also illustrate a "Soutterware"

FIG. 2.—"SOUTTERWARE" ELECTRIC TOASTER.

toaster (nickel-plate on brass), which will toast bread in four minutes on both sides. Ebony feet are used to insulate these articles from the table. A twelve months' guarantee of quality and workmanship is given. A number of other designs of kettles, besides that shown, also jugs, brass water heaters, coffee percolators, and sideboard heaters, are included in the Soutterware catalogue.

A New Lathe Tool.

THE MOTOGEAR ENGINEERING CO., of Brandon Grove, Ilford Hill, Essex, have recently introduced a patent self-contained lathe cutting-off tool, for cutting off tube, rod, &c., in the lathe.

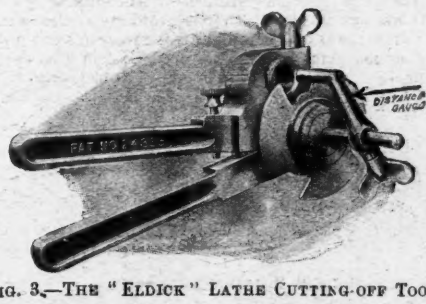


FIG. 3.—THE "ELDICK" LATHE CUTTING-OFF TOOL.

We illustrate this tool in fig. 3 ; as it is self-contained, it is not necessary to remove the tool from the slide rest, and a distance gauge gives exact reproduction for length. It is fitted with a

blade having three cutting edges, any of which can be put into operation by loosening the nut. The work being supported right to the cutting edge, all chatter is eliminated, thus keeping the cutting edge much longer than an ordinary tool.

The tool is designed to deal with diameters from ¼ to ⅝ in., and has found favour with many manufacturers of repetition work.

Switchboard for Messrs. Vickers' Canadian Works.

Messrs. Ferguson, Palin & Co., of Higher Openshaw, Manchester, have recently completed a new switchboard for Messrs. Vickers' new works at Montreal. This is constructed of slate panels, and includes three 650-kw. 460-volt three-wire rotary converter panels, fitted with circuit breakers, moving-coil ammeters, field regulating gear, &c., and isolating links at the back; a mid-wire panel with leakage indicator, automatic short-circuiting switch, &c.; and three 1,000-ampere and five 600-ampere feeder panels, each with circuit breakers, moving-coil ammeters, intergrating wattmeters, &c., and isolating links at the back of the board.

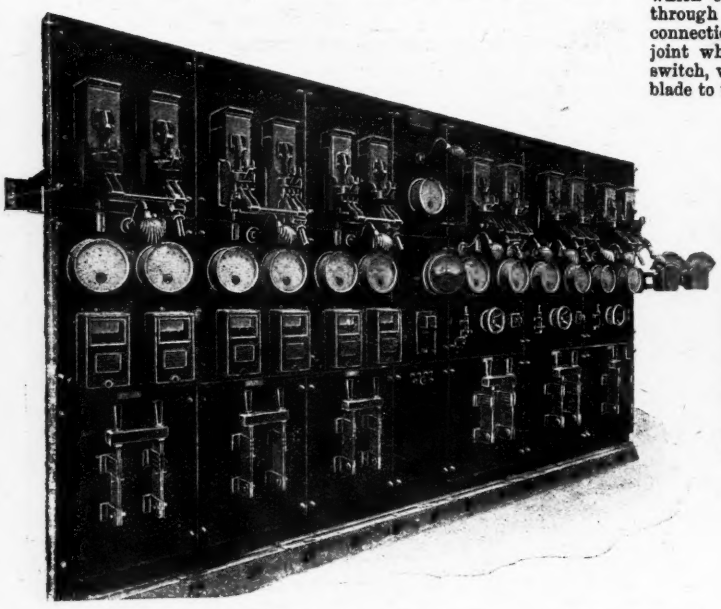


Fig. 4.—Switchboard Constructed by Messrs. Ferguson, Palin & Co.

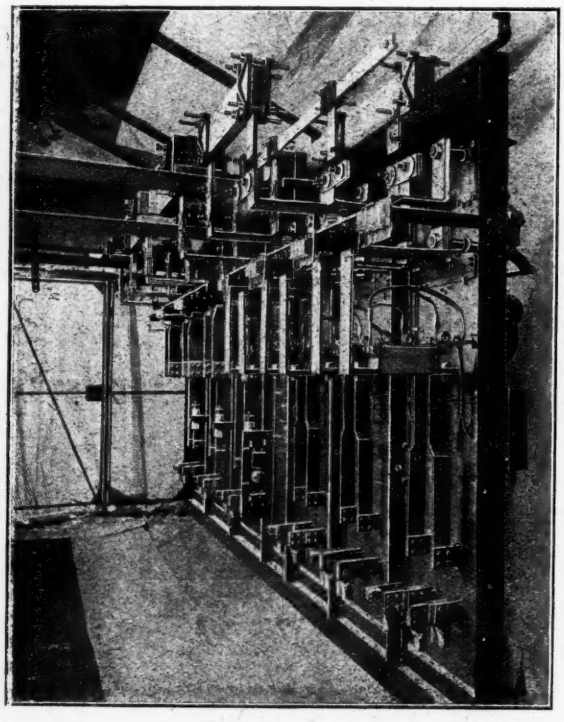


Fig. 5.—View Behind Board, Showing Isolating Links, &c.

A special feature is the provision of isolating links. These are seldom fitted on d.c. switchboards, and the reason they have not been more generally adopted, is probably due to the fact that an ordinary isolating switch of the "knife contact" type takes up considerable room. If, however, the links are made an integral part of the connections, as on this switchboard, no extra space is required. The isolating links are very useful, as if it is desired to work on a circuit-breaker, or any other piece of apparatus, it can be done without any danger; the tightening bolts come away with the links, the connections being slotted to allow of this, which means that the bolts need not be withdrawn, and pins are provided to prevent the nuts being unscrewed too far. Insulators are provided for supporting the connections, to make them stable after the isolating links have been opened.

The knife switches are of a unique design, which decreases the number of contacts the current has to pass through. The strips which engage with the blades on the front of the panel pass through to the back of the panel, and are drilled to take the strip connection or cable sockets as desired; there is no intermediate joint whatsoever. This is a marked advance on the stem type switch, which has two or three intermediate contacts from the blade to the connections at the back.

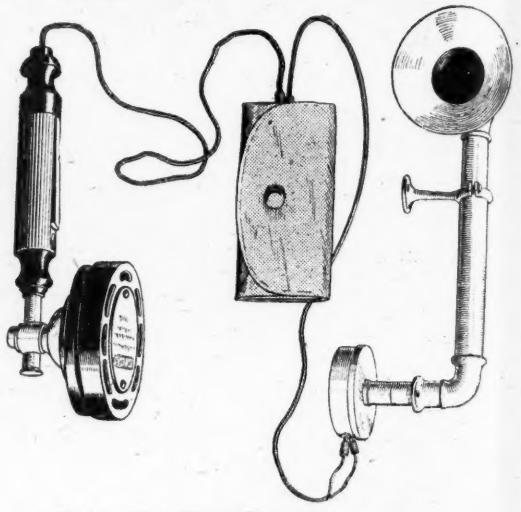


Fig. 6.—The Motor-Dictograph.

The bus-bars are of aluminium, insulated with mica and slate, and are laminated so as to give a maximum cooling effect. The outer bars at present have a sectional area of 7½ sq. in., and arrangements are made so that this can ultimately be increased to 15 sq. in. The bus-bars are not drilled excepting where they are coupled up to adjacent bars, all the circuit connections being clamped.

The shunts are mounted horizontally, so that a draught of air can pass between the strips to keep the shunt cool. The instrument fuses are brought well out from the back of the switchboard, so that it will be possible to withdraw them without any danger of coming in contact with live connections; the instrument wiring is of fire-proof wire, and is clamped with porcelain insulators.

The outer cables are led away at the bottom of the board so that there are no long straggling cables which so often are a source of danger. The neutral connections which have no switch-gear apart from the isolating links, have porcelain cleats provided for them at the sides of the panels.

The design and workmanship of the board are excellent, and the back connections are neat and symmetrical.

The day we visited the works a large amount of work was in progress, including 11,000-volt and 420-volt switchgear for the Manchester Corporation; 6,500-volt and 420-volt switchgear for Salford; 6,000-volt and 400-volt switchgear for Bury; 2,000-volt and 200-volt switchgear for Blackpool; 6,600-volt switchgear for Stockport; 6,500-volt switchgear for the Stalybridge, Hyde, Mossley and Dukinfield Tramways; 6,000-volt switchgear for the Leigh U.D.C.; and 22,500-volt switchgear for Messrs. Bruce Peebles and Co. for a Canadian works.

A Motor-Car Telephone.

The General Acoustic and Dictograph Co., Ltd., of 193, Regent Street, W., have sent us particulars of the "Motor-Dictograph," a telephone specially designed for use in automobiles. It consists of a hand-transmitter, battery and loud-speaking receiver, as shown in fig. 6. With this device instructions can be given to the driver without raising the voice, and will be clearly heard by him. The battery consists only of a small dry cell, which can be dropped into one of the side pockets, and can easily be renewed. Conversation inside the car cannot be overheard unless the contact-bar in the handle of the transmitter is depressed. The apparatus can easily be installed without skilled labour.

New Water Heater.

Messrs. Simplex Conduits, Ltd., of Garrison Lane, Birmingham, have recently introduced an electric water heater intended to give a continuous supply of hot water for domestic purposes, public lavatories, &c. We illustrate in fig. 7 the 10-gallon size; through the open door can be seen the heater, a small pocket or circulator, fitted with low-loaded elements mounted on either side (some 300 watts for a 10-15-gallon tank).

The water connection to the tank is through the stop cocks shown, which can be shut off and the circulator removed bodily without interfering with the tank or pipes.

An inner copper tank contains the water, and is heavily lagged to prevent loss of heat.

The apparatus is intended to remain in circuit all day, and to be

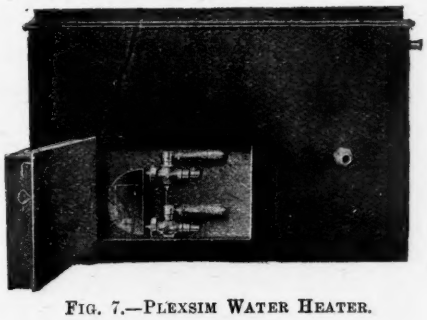


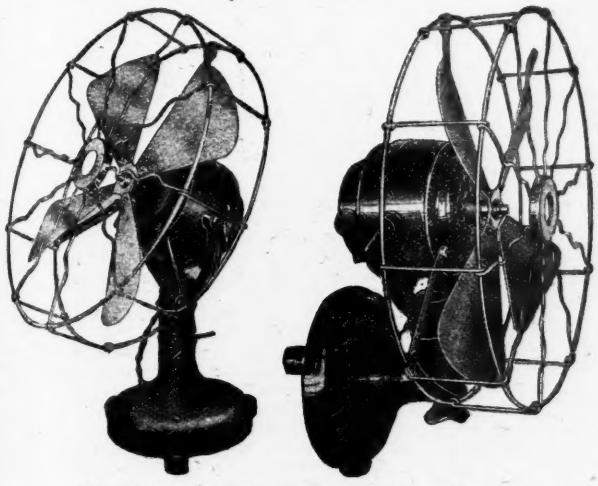
Fig. 7.—Plexsim Water Heater.

switched off at night; the fall in temperature during the night, from 20° to 40°, is quickly made up in the morning.

The tank always remains about half full of hot water, and as it is fitted with a ball valve feed, it is found that no great cooling of the water occurs in practice.

Ediswan Convertible Fans.

The Edison & Swan Co., of Ponder's End, Middlesex, have this season slightly altered the design of their convertible table-bracket fan. The illustration show the improved shape base. It will be seen that it is smooth, which allows a good space for high-class finishing, giving a superior, artistic appearance and reducing the



Figs. 8 and 9.—Ediswan Convertible Fan in Two Positions.

dust-collecting problem to a minimum. Every part is get-at-able and easily cleaned.

The fan is easily converted from a table fan into a bracket fan, as illustrated; one of its best features is the fact that it is both noiseless and sparkless.

When fixed in position no live parts are accessible, which ensures perfect safety. The blades are heavy brass, guarded by a ring wire guard.

The "Ediswan" convertible fan can be run at three distinct speeds, unlike many other similar articles on the market—and it is British made at the company's works in Middlesex.

Commercial Development.—A "special offer" is being made to all the consumers on the books of the Marylebone Electric Supply, in the form of a leaflet bearing the announcement:—"Upon receipt of your instructions we will send you an electric iron, toaster or kettle, as illustrated herein, and add 5s. to your account for electricity each quarter until the amount is paid off. No separate account. No charge for interest on amount outstanding." The result of this attractive proposition will be awaited with interest. There is no doubt, for experience has proved it a fact, that a practical trial in a small way of electrical aids to housekeeping very often induces a desire for more, and leads to gratifying developments. In this case the Council appears to incur no risk to speak of, and the consumer will not feel the burden of cost when paying by small instalments. It is a simple idea, but well worth imitation.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Meetings of the I.E.E.

There seems to be a fairly general opinion among members that there is something lacking in the Institution of Electrical Engineers; most people seem to find the proceedings dull and depressing, and this cannot surely be due to the nature or quality of the papers, but must in some way be due to the way in which the meetings are organised, or, perhaps, the *extent* to which they are organised.

The method by which the author is compelled to give a more or less garbled version of his paper, and by which the discussion is carried on only by those who have carefully prepared their remarks, is calculated to produce a result lacking in spontaneity and freshness, and as the closure is ruthlessly applied, whether the subject is thrashed out or not, there is at the end a feeling of incompleteness, and the usefulness of the discussion is much impaired.

The remedy is possibly difficult to find, but if not found the meetings will cease to attract, except as opportunities for social intercourse, and it is in this light that they are already regarded by many of those who attend them.

Another sign of decay is surely the mildness of the protests against the recent alterations in the form of the *Journal*, the method of packing it for the post, and the abandoning of the postcards announcing each meeting.

No one likes these things, but very few take the trouble to protest, unless, of course, the protests have been made, and ignored.

It is significant that there was a large falling-off in the numbers attending the last meeting, and it seems not unlikely that this decrease may be due to the fact that members are forgetting the dates of the meetings.

Finally, why is the annual general meeting held in the afternoon, when it is impossible for most members to attend? Surely it should be a matter of importance to get as many together as possible on that occasion.

This letter is written in the belief that many are in general agreement with the opinions expressed, and in the hope that it may stimulate a discussion that will bear fruit in future sessions.

E. S. Shoults,
Associate Member.

Finchley, *April 24th*, 1914.

Protection or Tyranny?

It would appear that Mr. Bruce Anderson desires to vindicate the honour of the B.E.A.M.A. (*i.e.*, of its corporate members). Very well, one does not envy him the task! At present do not let us be confused by "form." Mr. Fletcher put his case quite plainly, and suggested that our electrical companies (including, I suppose, the firm for which Mr. Anderson is responsible), have definite arrangements with other firms, or other members of the B.E.A.M.A., for the prevention of interchange of staff. And that is quite a fact. Say an engineer applies for a position with the firm mentioned. At first he may not mention the name of the firm he is with. He is interviewed and almost engaged. But naturally the name of his employer must come out, when the firm "wish to consider the matter further," and the applicant hears soon that they do not require his services "at present." Indeed such cases are now quite common, and Mr. Anderson surely knows it, even when for reasons of policy he apparently attempts to deny it; whilst the position is also known by many staff engineers who are in responsible positions with industrial firms, and who often deal with these "private and confidential" matters.

It is generally known now that competitive electrical firms have their "arrangements" like other firms, and for many of them, despite the assertions of Mr. Purse and others, they are fully justified. But it does not seem to be understood that they wish to eliminate internal competition as much as possible, to their mutual advantage all round.

And that is where, I take it, the interchange of staff has of necessity to be taken into account, since when engineers go from one competitive firm to another they obviously give the former an advantage over the latter, so that "the balance of internal competition" is affected.

The amazing thing is that employed engineers will not see the deep seriousness of the position. One imagines if they did, that if the full facts could be published or proved, the Staff Engineers' Association would become one of our strongest institutions, instead of drifting as it seems to do. Of course one must not suggest that Mr. Fletcher has not done his best at a thankless task, for which he deserves full credit.

Herbert Wilson.

Manchester, *April 27th.*

[Our correspondent has apparently misplaced the words "former" and "latter."—EDS. ELEC. REV.]

ELECTRICITY IN MINING.

AT a meeting of the MINING INSTITUTE OF SCOTLAND, held on April 11th, MR. ARCHIBALD M. RUSSELL read a paper on "The Sinking and Equipment of Blairhall Colliery, Fife." As the equipment has been recently fitted out, the following notes on the electrical plant, taken from the paper, will be found of interest:—The generating plant consists of two Willans mixed-pressure turbines of the disk-and-drum type coupled to Brown-Boveri three-phase generators, capable of giving an output of 500 KW. at 550 volts, 50 periods per second, at 3,000 R.P.M. The condensing plant is of the vacuum-augmentor type; it is capable of dealing with the whole of the steam from one of the turbines, and is supplied with cooling water from a Balcke cooling-tower.

The exhaust steam from the winding and fan-engines is delivered to a Rateau steam accumulator capable of dealing with 20,000 pounds of exhaust steam per hour and bridging over stops of 60 seconds.

The switchboard is of the mechanical remote-control type, arranged with the oil switches and bus-bars in cubicles. The wiring at the back of the board is carried out with asbestos-braided cable run on porcelain cleats. The generators are protected by time-limit overload relays and reverse-power relays. A Brown-Boveri regulator is fitted to control the supply pressure. The lighting of the colliery is taken from two 25-KW. three-phase transformers, either of which is capable of doing the work.

Three-core double-armoured vulcanised-bitumen cables are led into a brick-lined trench roofed with fire-clay covers, leaving room for future requirements. This trench passes the washer and the screens on the way to the shaft.

Two cables were taken down the shaft, each capable of supplying half the requirements. In addition, these cables are sectionalised at each pump-room. The cable is of the solid vulcanised-bitumen three-core double-wire armoured type, and for the suspension of the cables in the shaft, hard-wood cleats 5 ft. long were used at intervals of 150 ft., with intermediate cleats 2 ft. long arranged at distances of 30 ft. between the others. The reason for using long cleats of this description was that very little pressure between the halves of the cleats is necessary to hold the cable in place. With short cleats, on the other hand, it is necessary to put considerable pressure on the cable; if this be not done carefully, and if the cleats are not a true fit for the cables, there is risk of damage to them.

The earthing arrangements for the pit were carefully considered, in view of the fact that the new Home Office Rules were under consideration at the time when the installation was being erected, and a solid copper bus-bar is provided in the power house, also at each of the pump rooms, to which all armouring, motor-frames, &c., are carefully bonded. A cast-iron, heavily ribbed earth-plate is attached to the main earth-bar at the power station; another earth-plate is placed near the shaft top; and earth-plates are connected with the earth-bars in each pump chamber and immersed in the sumps, as it was found that, owing to difficulties in connection with the ground at the surface, this was necessary in order to secure an efficient earth. Tests taken after the earthing was completed proved the efficiency of the system.

An overhead line is taken to the river, from which is drawn the water supply for the boilers and for the cooling tower. Another overhead line is taken from the power station to Blairhall village for the purpose of lighting.

The whole plant has been designed to deal with an output of 1,500 tons per eight-hour day.

At a meeting of the MINING INSTITUTE OF SCOTLAND held in Glasgow, MR. WILLOUGHBY M. DUNN replied to the discussion which had previously taken place on his paper, "Electric Winding Plant at South Kenmuir Colliery." Referring to observations made regarding the failure of supply, Mr. Dunn said the plant had been running continuously for the last four years, and during that time not a single moment had been lost because of the supply failing. He could endorse all that had been mentioned regarding the reliability of power supply from the Clyde Valley Power Co. The escape shaft for South Kenmuir Colliery was half-a-mile distant at another of their pits, which had a steam equipment, and this had some bearing on their deciding to adopt winding by electricity. With, however, the experience of the past four years behind him as to the reliability of the power supply, he would have no hesitation in equipping both shafts with electrical winding gear. Regarding the question of wear and tear to winding ropes owing to the small diameter of the drum, he found that their life was considerably greater on the electric winder as compared with any of their steam winding engines, with cylindrical drums varying from 8 ft. to 11½ ft. in diameter. This he believed to be due to the steady and regular acceleration of the load by the electric winder, as compared with the more or less erratic and jerking start given to a steam engine by a large number of enginemen.

At the annual meeting of the West of Scotland Branch of the ASSOCIATION OF MINING ELECTRICAL ENGINEERS, a paper was read from MR. J. A. KERR, Natal, on "Hints for Colliery Electrical Plant." He was in favour of armouring and earthing if it were properly carried out and maintained, but in certain cases this was impracticable. Indeed, the time and money spent in efforts in this direction would be better utilised in making the insulation proof against the occurrence of faults, and in providing extra copper at lower pressures. In some districts it was difficult to get men at a reasonable rate sufficiently skilled to do this work properly. As a rule, it would be much safer on small installations if earthing were not resorted to until it was found possible to get a sufficient difference of potential between each piece of apparatus and earth to cause danger. This would help to raise the standard of insulation. There must be two faults on an insulated system to get a shock to earth. It would not be hard to find places on such a system where a person might come against live metal with one hand and the case of a switch or motor with the other and not receive a shock, whereas if the case was earthed and a fault occurred on another part of the system, or there were a number of small leakages, the result might be serious. Mining practice in Natal, till within a few years ago, confirmed this view. Bare wires were run along the sides of the roads; this practice was very properly stopped by the Mines Department, the pressure being 250 volts. The coolies and natives worked barefoot and almost naked. Earth wires were unknown. Contact with live wires and apparatus must have been of daily occurrence, yet with the exception of one doubtful case, there was no record of any fatality. In many mines in the West of Scotland much could be said for the unarmoured unearthed system. Other industries offered attractions and less onerous conditions to skilled electricians, with the result that men competent to keep the earthing right were hard to retain.

Far too much had been made of the risk of fire on unarmoured systems through defective jointing. If the resistance of a joint was high enough to cause heating and ignition of the insulation, it would be detected in the working of the apparatus it had to supply. With large strand-filled cables there was difficulty in getting the joints properly sweated, but a stepped mechanical joint would overcome this. Theoretically, in a long cable the copper should become longer than the iron-wire armour with a rise in temperature. In one instance a three-core, 0·25-sq. in. double-wire armoured bitumen cable went to earth about 600 ft. down a shaft where the temperature varied from 70° to over 100° F. It was found on cutting out the fault that the cores were badly decentralised. The makers could find no fault with the method of fixing, which was done with cleats 3 ft. long fixed to the buntons. The cable had never been worked at a greater density than 700 amperes per sq. in., and it was probable that the unequal expansion and contraction of the copper and iron caused the trouble. This cable subsequently decentralised at various places and had to be taken out. It was not advisable to attempt to locate a fault in bitumen cables by burning out, as the current might be sufficient to decentralise the cores.

It was high time, continued the writer, that slate switchboard, were done away with for anything over low pressures. Unless substantially bushed and faced with mica for underground work the insulation was not reliable. He thought the members of the Association should form a committee to pass and approve such apparatus. The joint experience of a number of members would ensure a sound verdict, and would benefit both the buyer and the manufacturer, as the latter would have defects and objectionable features pointed out to him, while the former could safely accept what had been approved by the inspection committee of the Association. A system of file cards was of great value, and should be in use wherever electrical plant was operated. Each motor should have a card bearing the following particulars:—Name of maker, date of delivery, date when put to work, number, voltage, current, horse-power, speed, size of fuse wire or current at which circuit-breaker would operate, where situated, date and nature of repairs and by whom repaired, material used for repair, stores allowed, &c. Wherever possible, machines, motors and switchgear should be standardised, thus enabling spares to be stocked and allowing repairs to be quickly carried out. Such a system had the advantage that, having the characteristics of fewer pieces of apparatus to study, men could more quickly locate and repair faults, put parts together again, and better guard against the possibility of breakdown occurring. Some men at present seemed to think that the colliery was run for the electrical installation, and not *vice versâ*. This attitude did an immense amount of harm, and it behoved those who were operating and maintaining plant, to exercise the strictest economy consistent with safety, not only for their own good, but for the welfare of the mining and electrical industries.

Strike.—There has been a strike of carpenters at the Woolwich Works of Messrs. Siemens Bros. & Co., Ltd., "as a protest against labourers being compelled to do joiners' work."

COMPARATIVE ECONOMICS OF TRAMWAYS AND RAILLESS ELECTRIC TRACTION.

In a paper on this subject, read before the Institution of Civil Engineers by Mr. T. S. Gribble, on March 25th, the author endeavoured to arrive at a definition of the sphere of usefulness open to the railless system. He submitted evidence that for urban and suburban transportation, track-laying had been carried far enough, and in many cases too far, maintaining that wherever overhead wires could be employed, railless electric traction afforded the best means of extending the tramways. The development of the railways had brought about over-centralisation of the population, necessitating the adoption of means for decentralisation, such as electric traction, without the heavy burden of permanent way; at the same time this would enable a supply of electricity to be given to sections of the population which at present lacked that advantage.

Comparing railless with tramway traction, the main distinction commercially was that with the former the capital expenditure on permanent way was saved, and the cost of maintenance of rubber tires was added. Other expenses might, for practical purposes, be taken as equal in the two cases. The railless cars at present in use were single-decked, with a seating capacity for 28 passengers, but double-decked cars with 38 seats would probably come into use. As the average number of passengers carried on British tramways did not exceed 13, and might be taken as 9 for traffic of average density, the single-decked railless car could cope with such traffic. The use of trailers, which was general on the Continent, would much enlarge the capacity of railless electric traction for handling special traffic, and would permit the weight of the power-car to be reduced, with advantage to the maintenance of the roads.

An analysis of the capital expenditure on British tramways, embodied by the author in curves, illustrates the remarkable variations between the different undertakings; but by taking into consideration as far as possible the effect of local conditions, the author has endeavoured to arrive at normal figures. For redemption of capital a period of 30 years is allowed, and the rate of interest at which the undertaking can be described as remunerative is put at 5 per cent. The author thus obtains the results shown in fig 1. By an analysis of the working expenses of 47 British tramways he finds the working expenses amount to 6.47d. per car-mile, on the average; but thirteen tramways, of which the working expenses exceed 7.5d. per car-mile, give an average of 7.82d., and 17 below 5.5d. give an average of 5.26d. per car-mile. Power expenses range from 0.767d. to 2.212d. in these cases, with a general average of 1.282d. per car-mile. For railless electric traction the working expenses average 6.75d. per car-mile, including 0.765d. for power and 1.5d. for rubber tires, the latter item comparing with 0.421d. for permanent way in the case of the tramways.

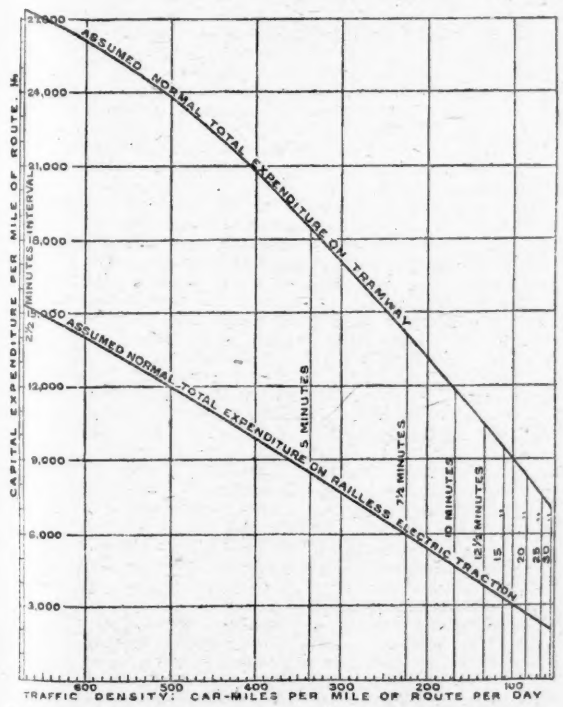


Fig. 1.—Tramways and Railless Traction, total expenditure.

The cost of energy is in most cases the principal cause of abnormal results, and the author points out that in many cases tramways which purchase energy could make a great saving by putting down their own plant.

The cost of construction of a railless system has been taken as equal to that of a tramway, including the power-station, but minus the track. Experiments made by the author on various occasions show for a car weighing 5 tons loaded, on a macadamised road covered with snow, a consumption of energy varying from 0.9 kw.-hour per car-mile on the level to 1.075 on a 5 per cent. gradient, at a schedule speed of eight miles per hour. On gradients from 6 to 9 per cent., at a schedule speed of seven miles per hour (maximum ten) the energy ranged from 1.085 to 1.45 units per car-mile. For power station plant the author allows 25 kw. per car in service, including reserve. The figure chosen for maintenance of rubber tires (1.5d. per car-mile) depends upon the price of rubber, the condition of the road surface, etc. Contracts have been made at 1d.

Regarding the wear of the highways, the author points out the difficulty of apportioning responsibility at a time when the world is passing through a revolution in highway transportation, and the fact that roads are maintained by local authorities, though used largely by the inhabitants of other districts. He considers special legislation necessary, and he points out that the railless car is at present handicapped as compared with the motor omnibus in that overhead wires can only be erected under a costly special Act of Parliament, and that the 'bus makes no contribution to road maintenance. Ususally the railless service is called upon to pay up to ¾d. per car-mile towards the cost of maintenance, at which rate a 2½-minute service would contribute nearly £400 per mile of road per car per annum.

The author's final comparisons are shown in fig. 2. He finds:—(1) That with a traffic-density represented by a 2½-minute service, the cost of working is still in favour of railless electric traction, although only to the extent of about 7 per cent. The cost of construction is, however, about 44 per cent. less.

(2) That the saving increases inversely with the traffic-density, so that with a time-interval of 30 minutes the cost of operation is about 36 per cent. less, and that of construction about 70 per cent less.

The opinion that the economy of the "trolley-bus" ceases at a service frequency of about 10 minutes, is, in the author's opinion, quite unfounded.

The tramway cannot serve the public as comprehensively as the "trolley-bus." In order to serve the city best, the aim should be to reach the farthest suburb, and to supply the greater frequency of service in the centre of the city by means of overlapping services radiating to the suburbs, precisely as is done by the London General Omnibus Company.

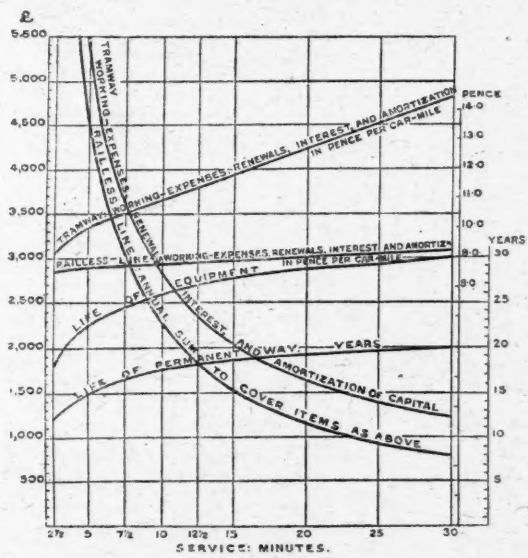


Fig 2.—Comparative Economics of Tramways and Railless Electric Traction.

The curves in fig. 2 are based upon the following assumptions: Length of route, 1 mile. Length of traffic-day, 14 hours. Scheduled speed 7½ m.p.h. No. of cars in service, car-mileage per day ÷ 105. No. of cars in stock, car-mileage per day ÷ 70. Power-house capacity, 25 kw. × No. of cars in service. Cost of power-house with plant, £500 × No. of cars in service; rolling stock, £750 × No. of cars in stock; land and car-sheds, £200 × No. of cars in stock. Cost of electrical equipment, from £3,000 to £1,000, and of track from £12,000 to £5,000 per mile of route, depending upon the traffic-density.

CURRENT-LIMITING REACTANCES ON LARGE POWER SYSTEMS.

(*For abstract of paper read by* Messrs. K. M. Faye-Hansen *and* J. S. Peck *before the* Institution of Electrical Engineers, *see* Elec. Rev., *p.* 609).

Discussion at Manchester.

Mr. McKenzie said it was now generally recognised that reactances in some part of a large generating station were highly desirable as a means of reducing the disastrous effects due to short circuits on feeders and busbars. In laying out a new system most engineers would agree that correct place for reactance was in the busbar sections, because the feeders and generators should be so arranged that there was very little interchange of power between the different sections. In the case of extensions having taken place over many years and larger units added, it was a difficult matter to decide where reactances should be placed, as under certain conditions great interchange of power might take place. He was of opinion that it was best in such circumstances to place the reactances in the generator leads to limit the short-circuit current on the generators to 7 or 8 times the normal. Care had to be taken, however, to ensure that the rotor windings would withstand the overload necessary to compensate for the drop in pressure across the reactances. He thought the authors had rather magnified the effects of short circuits on feeders. During the last ten years at Stuart Street, Manchester, 90 per cent. of the faults on the system had originated in one phase. If proper balanced protection was fitted to each of the feeders, then in nearly every case the feeders would be brought out without much damage. Faults such as these seldom developed into shorts between phases, the neutral being earthed through a resistance. The same remarks applied to generators with balanced protective gear. In the case of a new system, it seemed desirable to build generators and transformers to have the necessary reactance in themselves instead of a separate piece of plant.

Mr. S. J. Watson said it did not seem right to run plant with an output of 80,000 to 100,000 kw. on one set of busbars, as even with reactances certain conditions might be set up which would result in disaster. Higher reactance in the generators themselves could be obtained at the expense of regulation, and the prime cost was lower.

Mr. W. Tallent Bateman said reactances should be considered more from the point of view of switchgear protection, since a switch might be called upon to interrupt the current from several generators in parallel. The largest type of oil switch was not capable of dealing with a greater momentary short-circuit capacity than about 250,000 kw., so that when this figure was exceeded reactance was essential. A type of reactance switch used successfully by the American Westinghouse Co. consisted virtually of two oil switches, one of which had a reactance in series, coupled in parallel. The single switch operated first, leaving the second switch and reactance in series, and finally the second switch operated, thus keeping the current within the limit of circuit-breaker design.

Mr. H. A. Ratcliff thought that in the future design of generators and transformers it would be found desirable and even necessary to introduce internal reactance for their own protection. The principal use of external reactances would be in sectionalising busbars and protecting switchgear. One great advantage of external reactance coils was that under abnormal conditions the mechanical and electrical strains in a circuit were presumably greatest where the reactance was greatest, and reactance coils could be more easily constructed to withstand these strains than generators. The possibility of varying the reactance of external coils was also an advantage. The modern H.T. oil switch could deal better with pressure rises than heavy current rushes.

Dr. G. W. Worrall said that whilst reactances in the generator circuit would certainly limit the rise of current at the source, there would be a danger of reduced busbar pressure. Busbar reactance gave rise to errors in the switchboard instruments, unless the Continental practice of having the instruments on another floor of the building were adopted. The most serious objection to the use of these reactances was the introduction of another link into the existing chain of weaknesses.

Mr. Blackmore said he had experienced a great deal of trouble due to short circuits on mains and generators, and all the devices tried hitherto had introduced more trouble instead of avoiding it. In addition to end-connection trouble in turbo-generators, he had encountered breakdowns due to local heating of the laminations during short circuit. The two-circuit-breaker method, which introduced a reactance after the first breaker had operated, was unsatisfactory, as the initial rush was not met by the reactance, and damage ensued. He appealed for a device which would save switchgear and mains, and not introduce more trouble.

Mr. D. B. Mellis said that a reactance coil to be efficient should have practically constant induction for all values of current passing. When iron was employed within the coil it would soon become saturated, and the induction density would fail to be proportional to the applied ampere turns. Armature reaction was not of value for keeping back instantaneous short circuits, only armature self induction, which was controlled by the induction density possible in the iron within the windings. For this reason it appeared that in no case could safety be ensured without external reactance, the coils of which should be as free from iron as possible. The use of reactance coils normally short-circuited was not to be advocated.

Mr. Eustace Thomas said the principal importance of the use of reactances arose from the following:—(1) That machines were not safe against the stresses of short circuit; (2) that oil switches as now made were not safe protectors of the plant installed under emergency conditions; (3) that by limiting the amount of current that could flow if a feeder or generator broke down, a shut-down might be avoided. The paper was a manufacturer's paper, and as the design and construction of machines and oil switches had been entirely in the hands of manufacturers, this admission of weakness would be felt by users of large electrical plant to be most serious. Regulation was recognised as now no difficulty, and it was agreed that higher internal reactances must again be employed. In the same way still better clamping and support for the end connections of armature coils were required and perfectly possible. The lack of safety in modern oil switches was a much more serious matter, and it appeared that manufacturers were trying how small they could make the appliances upon which the ultimate safety of plant costing hundreds of thousands of pounds depended. Bad shorts in the station itself could be almost eliminated by adopting certain simple precautions. The reactances would have to be well built and have the phases well separated, otherwise they would introduce more risk in themselves than the damage which they protected against.

Mr. S. Ferguson considered that reactances should be placed directly in the generator leads. Two miles of .15 sq. in. cable was as effective in limiting the current on a 6,000-volt system as a 3 per cent. reactance coil. Feeder reactances were certainly useful in preventing the fall of busbar pressure in the event of a short on a feeder, but the cost was scarcely warranted in view of the rare occurrence of feeder shorts. Generator reactances also reduced the strain on the switchgear of the whole system.

Dr. E. Rosenberg said that in the early days of electrical engineering there was no need for artificial reactance. For the present no doubt these additional reactance coils were necessary in order to limit the effects of short circuits, but they had not come to stay. Generators were now built which could withstand the effects of short circuit (not necessarily any number of shorts). The cumulative effect would arise not only on the end connections, but under certain conditions in the rotor, especially if excited from busbars with considerable resistance in series. Transformers were now designed to stand dead short circuits. The extremely close regulation had been done away with by increasing the internal impedance from 1 per cent. to about 4 per cent., and the short-circuit current had consequently been reduced from about 100 times to 25 times normal. Additional reactance in the line was necessary because present-day cables had such an extremely low reactance; the possibility remained of getting a feeder with a moderate amount of inherent reactance by using either single-core cable throughout or a combination of single and three-core. Of course, iron armouring in the manner adopted for D.C. single-core cables would not be used, but the problem of effective sheathing could be solved. A natural reactance would then be obtained, also increased safety between phases.

The Authors, in reply, agreed with Mr. McKenzie, that it was very difficult in the case of extensions to decide where reactances should be placed, and also how to arrange them. This was one reason why care had been taken in the paper to avoid laying down rigid rules regarding the position of reactances. Whilst feeders and generators usually broke down first to earth, it was to be remembered that a good number of faults were due to mechanical damage. Subsidence of soil, for example, might produce heavy shorts between phases; no protective gear yet devised was quick enough in operation to deal with such a case, and reactance in the circuit had to be resorted to. Where transformers were used in series with generators, it was satisfactory to good practice to put the necessary reactance in the transformers. The tendency at present was to build large stations and connect to the same busbars; there were good economical reasons for this tendency, and the authors believed that the capacity of generating stations would get larger and larger. Regarding the size of reactance coils, the 720-k.v.a. reactance coil mentioned would correspond to a 20,000-k.v.a. alternator. The cost was certainly a serious matter, on account of the necessity for dealing with the k.v.a. on short circuit. Taking the k.v.a. rating of such a reactance coil, the cost would be in the neighbourhood of that of a transformer of 5 to 10 times the capacity. The losses in reactance coils were very small indeed. It was true that a cheaper generator, and also one with higher efficiency could be built where regulation was not so important. The two-breaker method limited the current, but the same result could be obtained by using one switch with auxiliary contacts. The breaking capacity could be brought up to anything at present required, but it involved expensive switchgear, and the reactance coil had not only to protect the switches, but also to keep up the voltage on the other parts of the system during the fault. Reactance coils were in use by the London Electric Supply Corporation, the London County Council, and on the North-East Coast. The probability of resonance was not increased by the introduction of reactance coils. The authors did not agree that no iron should be used in these reactances; if the iron was kept well away from satura-

tion it would behave as well under short circuit as under normal conditions. It was certainly advisable to have very ample oil switches, and this with the generator strengthened would reduce the number of places where reactance coils were required. It would not be wise to design a big station without reactance coils unless it could be laid out with transformers designed to give the necessary reactance. Regarding the capacity of switches, probably the best way would be to state the K.V.A. which could be broken without rendering the breaker unfit for service.

LEGAL.

Marx *v.* Electric Utility Co., Ltd.

Question of an Assigned Debt.

In the King's Bench Division on Wednesday, April 22nd, Mr. Justice Atkin sitting without a jury, had before him this action, in which the plaintiff, Mr. Carl Marx, residing at Lauderdale Mansions, Maida Vale, London, W., proceeded against the Electric Utility Co., Ltd., of 35, King Street, Cheapside, E.C., to recover £300, which it was said represented a debt due from the defendants' predecessors, the Electric Lamp Regenerators, Ltd., to a Dr. Seigbert Bloch, of Berlin, which debt was assigned to the plaintiff by a deed of September 24th, 1913. The defendant company, it was said, had taken over all the assets and liabilities of the old company, the Electric Lamp Regenerators, Ltd., and had assumed responsibility for the payment of the debt to the plaintiff or Dr. Bloch's assignee. The defendants denied that they ever acknowledged responsibility for the debt as affecting the plaintiff, and they said that the old company agreed to pay Dr. Bloch £300 out of the first moneys accruing through the sale of certain South African patent rights, and that, in fact, no money had so accrued.

Mr. J. B. Matthews, K.C., and Mr. Romer Macklin appeared for the plaintiff, and Mr. Hollis Walker and Mr. Morris represented the defendant company.

Counsel addressed the Court at great length, and his Lordship gave judgment for the defendants, with costs.

Osram Lamp Works, Ltd., *v.* The Austrolite Co.

On April 24th this case was mentioned to Mr. Justice Joyce upon a motion by the plaintiffs for an interim injunction.

Mr. Walter, K.C., for the plaintiffs, said the action was in respect of two patents for the manufacture of metal filaments, the validity of which had been certified after a long contest. This motion came before the Court in October last, but stood over with a view to settlement. The negotiations had, however, come to nothing.

Mr. Newbolt, for the defendant company, said his clients were only the retailers of the article in question, and had an indemnity from their vendors in Vienna. The negotiations had been between the plaintiffs and the vendor. Defendants did not know whether the articles in question were infringements. But they could not afford to fight a patent action. Again and again they had asked their vendors to undertake the defence, but that had not yet been done.

His Lordship: Why don't you undertake not to infringe without prejudice to any question?

Mr. Newbolt: Perhaps that would be the best thing to do.

His Lordship: If I were in your position I would do so, and then give notice to your vendors that you are not going to defend.

An undertaking was accordingly given until the trial.

Bailey and Others *v.* The Manchester Corporation.

New Trial Ordered.

In the Court of Appeal on the 23rd inst., Lords Justices Buckley and Kennedy, and Mr. Justice Scrutton, disposed of this case, on an application by the plaintiffs, asking for a new trial, the action having originally been heard at the Manchester Assizes, before Mr. Justice Lush and a special jury. Mrs. Annie Bailey brought the action on behalf of herself and her seven infant children, claiming damages for the loss of her husband, John Bailey, a hansom-cab driver, who was killed in a collision with a Corporation electric tramcar. The accident occurred when the deceased was in the act of turning his cab into Queen's Road from Park View, Manchester, and plaintiffs alleged that it was due solely to the negligence of the driver of the tramcar. The defendants denied negligence, and pleaded contributory negligence. At the trial, the jury found for the defendants, and judgment was entered accordingly. The ground of the appeal was alleged misdirection of the jury by Mr. Justice Lush "in directing them that only in the event of their finding that deceased was not guilty of any negligence, were plaintiffs entitled to recover."

Lord Justice Buckley, giving judgment, said that the point of misdirection alleged, was that Mr. Justice Lush had not put before the jury that which, in the words of the late Lord Penzance, was expressed thus:—"Though the plaintiff may have been guilty of negligence, and although that negligence may, in fact, have contributed to the accident, yet, if the defendant could in the result, by the exercise of ordinary care and diligence, have avoided the mischief that happened, the plaintiff's negligence will not excuse him." It was necessary to look at the summing-up to see whether in this case the learned Judge brought to the minds of the jury that point of law for their consideration; whether, in other words, he directed them that supposing they found that the cab driver hesitated, or pursued an erratic course, yet, nevertheless, if they found that the tramcar driver could, by reasonable care, have avoided the accident, then the plaintiffs were entitled to a verdict. Having referred to the summing-up, Lord Justice Buckley said that, in his opinion, the jury's attention was not called to the relevant and material question indicated, on which the action ought to have been decided. Therefore, though with regret, he came to the conclusion that there had been misdirection, and, consequently, there must be a new trial.

Lord Justice Kennedy, concurring, said he shared the regret expressed by Lord Justice Buckley, but he thought that justice required that there should be a new trial.

Mr. Justice Scrutton took the same view.

Plaintiffs were given the costs of the appeal, the costs of the first trial to abide the result of the re-hearing.

Breach of Regulations.

At South Shields Police Court, on April 23rd, Messrs. Pyman, Bell & Co., Ltd., were summoned under the Factory and Workshop Act, on a charge of having failed to cover certain overhead wires with insulating material, or so to place and safeguard them as to prevent danger so far as was reasonably practicable. Mr. W. B. Lauder, Inspector of Factories, prosecuted, and Mr. F. Kidd defended.

Mr. Lauder, in explaining the facts of the case, said the defendants occupied a portion of ground at Tyne Dock, and there they stored pit-props. There were five circular saws driven by electricity, which were used to cut the props into the requisite sizes. For the purpose of conveying the current to the electric motors which drove the saws, there were three electric overhead wires, 22 ft. from the ground, and they were supported on wooden poles. On March 12th, a man named Samuel Beck, who was employed by the defendants, was engaged on the stack of pit-props 17 ft. high, and was throwing down the props to other workmen who were loading the wagons. While the work was in progress, one of the men noticed that there was something wrong with Beck, and on climbing to the top of the stack, he found him in a state of collapse. The three wires had sagged down, one being under Beck, another across his chest, and a third gripped in his right hand. At once the current was cut off, but the man was already dead, having received an electric shock. It was not definitely known how the accident had occurred, but at the inquest the opinion was expressed by the engineer and the foreman that Beck had probably slipped on the round props, and, in trying to recover his balance, had grasped the electric wires in his hand, and pulled them down on top of the stack. At the time of the accident two layers of props had been removed, and that left a space of 6 ft. between the top of the stack and the wires. The breach of the regulations was that the defendants had failed either to limit the height of the stacks or to insulate the wires so as to protect the workmen from possible danger.

Mr. Kidd admitted the facts, and the breach of the regulations, but pointed out that two of the workmen who gave evidence at the inquest said that it would have been impossible for the deceased to have taken hold of the wires. It was one of those accidents that it was impossible to foresee, and his clients were exceedingly sorry for what had occurred. They had voluntarily paid the funeral expenses of the dead man, and they were prepared to carry out any suggestions that might be made by the factory inspector. He added that the wires were at the usual height, and it was not necessary for the men to get on to the stacks to remove the props.

The Magistrates imposed a fine of £5 and costs.

Factory Acts Prosecution.

At the Durham County Petty Sessions, on April 22nd, the Coal Distillation Co., the occupiers of by-product works at Littleburn Colliery, were charged under the Factory and Workshops Act with having neglected to have certain electric wires covered with insulating material or otherwise protected, as a result of which a fitter's assistant named Joseph Edward Blackburn was killed in February.

Mr. W. B. Lauder, Factory Inspector, stated that the electric wires, which were entirely bare, were situated 44 in. above the steam valves, and anyone wishing to operate the valves must of necessity be in close proximity to the wires. On February 4th last Blackburn and another workman were busy connecting certain steam pipes, and evidently Blackburn came into contact with the live wire, while he had been attempting to open a steam valve. Nobody actually saw the accident, but he was found immediately below the wires unconscious, and died despite resort to artificial respiration.

Mr. Turnbull, for the defendants, admitted that Blackman died from electric shock. The works were constructed by tender, in which it was plainly stated that they had to be erected in full compliance with the Board of Trade regulations. His (Mr. Turnbull's) clients had already done their duty so far as the relatives were concerned, the sum of £228 having been paid in compensation. He mentioned that Blackman really went into danger by walking along the pipes instead of moving the ladder to a suitable position.

The Chairman said there had been a technical offence, and the magistrates would impose a nominal fine of £10, and costs.

Mackie *v.* Geo. Bland and The London Hydraulic Power Co.

This case was mentioned to Mr. Justice Joyce, in the Chancery Division on April 24th, upon a motion by the plaintiff to restrain the defendants from interfering with a private roadway from the plaintiff's premises to Old Street, E.C.

Mr. Erington, for the plaintiffs, said that his clients were electrical engineers, with large contracts with the Marconi Co. and other people, which had to be completed within a certain time under heavy penalties. Thus it was essential that the roadway should not be disturbed, in order that the machinery might be delivered. Plaintiff was the lessee of the premises in question.

Mr. Barber, for the defendants, said the London Hydraulic Power Co. were in the position of contractors who had an order from the plaintiff's dead lessor to lay certain hydraulic mains. The work would be finished by Tuesday, and the administrator of the lessor's estate would give an undertaking in damages.

On this footing the motion stood over.

Biggs *v.* Anderson.

At Liverpool Assizes, on Friday, Charles Arnold Biggs (15) brought an action against Messrs. Thos. Anderson, Ltd., electrical engineers, for damages for personal injuries. Mr. Gordon Hewart was for the plaintiff, and Mr. Greer for the defendants. The case for plaintiff was that whilst in the employ of the defendants, he was instructed to attend to some dangerous machinery—a motor disintegrator—in which a wheel revolved at a rate of 220 miles per hour. The plaintiff was told to shovel into the machine some blocks of compo taken from the outside of the boilers. While doing this, a piece of metal which had got into the disintegrator, flew out and struck him in the left eye, which was so badly injured that it had to be removed. Mr. Greer admitted that the defendants were obliged to compensate under the Workmen's Compensation Act, but for the purposes of the present action, the jury had only to consider his claim in common law. He held that the machine was not dangerous, and was as securely fenced at the time of the accident as it possibly could be. The jury found for the plaintiff, awarding £250 damages.

War Office *v.* Kirkland & Capper and J. H. T. Woodd.

On Tuesday, April 21st, the first day of the Easter legal sittings, Mr. Justice Lawrence resumed in the King's Bench Division the hearing of this action. At the conclusion of the last sittings the evidence in the case had been completed, and his Lordship now proceeded to hear the addresses of counsel in the case in summary of the evidence.

Mr. Montague Shearman, K.C., first addressed his Lordship on behalf of the architect, Mr. Woodd. He contended that no case was made out against his client. Upon the construction of the contract, he argued Mr. Woodd was to be remunerated at the rate of 5 per cent. on the cost of the works completed under his direction, and that did not include the electrical work. The contract as between Mr. Woodd and the War Office contained a provision that there should be a responsible expert for the electric lighting.

Mr. Justice Lawrence said it seemed to him that the suggestion of the War Office was that Mr. Woodd interfered and said "you must put in this system."

Mr. Shearman, K.C., said that upon the documents Mr. Woodd could not be held responsible, as it was not correct to say that he "gave directions."

Mr. Walter, K.C., addressed the Judge at length for the defence of Messrs. Kirkland & Capper. After submitting that no case of professional negligence could lie upon the documents against Messrs. Kirkland & Capper, counsel referred satirically to the adverse comment made by the War Office against the lead-covered system buried in plaster. It was provided by the specification that the conductors could be run in plaster in short lengths, and who was to judge what was a short length if the supervising engineers were not to do so? No single instance of a defect could be pointed out as being attributable to any lack of protection. He submitted that upon the terms of the specification Messrs. Kirkland & Capper were authorised to do just what they did, the system broke down not by reason of the lead-covered wire system that Messrs. Kirkland & Capper installed, not through any lack of supervision, but because of the absolute ineptitude of those who meddled with the system after it was installed, and the negligence of those who had charge of it. The whole action was founded on prejudice by the War Office against this lead-covered system. Counsel proceeded to submit that it was clear upon the evidence that every fault occurred at used points. There was no case proved where the fault originated in the lead-covered cable.

The Solicitor-General addressed his Lordship on behalf of the War Office. There was the plainest intimation in the specification, he said, that the conductors were not to be run for long lengths in plaster. It was provided that there should be accessibility; it was suggested by the defendants that this meant that the two ends were accessible. Accessibility meant that you could get at the wire if you so wished, take the wire out, examine it to see what was wrong and put it back. The language of the contract was reasonably clear that these lead-covered conductors were not to be run through plaster indiscriminately, and yet they had the spectacle of Mr. Woodd arranging with Mr. Kirkland for the specification to be departed from because Mr. Woodd had never taken the trouble to look at the specification to see if the system was allowed. Mr. Woodd's duty was to control the electric lighting specification, and the fact that he did not trouble to inquire into it was an act of negligence. It could not be said that the system was a better one; the system stood condemned by electrical engineers. It had not been established by the defence that the lead-covered wire failed because it was over fused. There was no accessibility because you could not get at the wires without cutting the place to pieces.

At the conclusion of the Solicitor-General's speech Mr. Justice Lawrence reserved his judgment.

Goodbody *v.* Poplar Borough Council.

In the Bow County Court on Monday, before his Honour Judge Bray and a jury, Christopher Goodbody, a bricklaying contractor, sued the Poplar Borough Council for damages for personal injuries.

Mr. Clements, barrister, appeared for the plaintiff, and Mr. Harris was counsel for the defence.

Plaintiff's case was that as he was walking along Bow Common Lane the cover of an electric chamber on the pavement blew off through an explosion, knocking him violently up against a public house. He saw blue flame, water and steam come out. He was unconscious for over half an hour, and afterwards thought he would be bound to lose his sight. He had been earning £3 to £5 a week up to the time of the accident. He was attended by doctors afterwards for seven months for a nervous breakdown, from which he had not even recovered now.

Dr. Power, for the defence, said all plaintiff was suffering from was disuse of the muscles.

Mr. Ingle, of the electricity department of the Poplar Borough Council, said fusing was a protective measure. No explosion such as had been described could have occurred, as there was no water in the box. He thought it extremely probable that the spark that always came at the severance of the fuse would get out through the joints of the cover, no matter how tightly they were sealed. That spark would be quite sufficient to explode an accumulation of coal gas, and that would lift a pavement cover if there was a sufficient accumulation. It was impossible to prevent gas getting into the chambers, and it was a source of very great trouble to them and to all electrical supply concerns at all times. The gas companies were always informed of an accumulation of gas when it was discovered. Round this particular box there were a large number of gas mains, which would be, of course, a source of danger.

Mr. Beauchamp, of the East Ham Corporation electricity department, said the greatest care was exercised to prevent the accumulation of gas and sir, without which such an explosion would be impossible. It could have nothing to do with the electricity alone.

The question left for the jury to decide was as to whether this chamber was a nuisance on the highway. They decided it was neither a nuisance nor a danger, and Judge Bray said that entirely disposed of the case so far as the jury were concerned. If counsel desired to have any legal arguments as to the matter they could arrange a day, otherwise the verdict was for the defendants.

The Statute of Limitations.

At Blackburn County Court on Monday, Judge Sturges gave a decision of considerable importance to tradesmen. A claim was brought against a debtor, and as the debt was contracted 13 years ago, the debtor's solicitor raised the Statute of Limitations as his defence. The debtor himself, upon being called in regard to another part of the amount alleged to be owing, admitted the old debt, whereupon Judge Sturges ruled that he had thus destroyed the protection afforded him by the statute. In the opinion of the judge, such an admission as the debtor had made on oath amounted to the withdrawal of the plea that the debt was statute barred, and he therefore gave judgment for the plaintiff for the whole amount. Judge Sturges added that, in view of the importance of the matter, he would give leave to appeal.

Stephenson *v.* Colne and Trawden Light Railway Co.

At Colne County Court on April 28th Judge Graham, K.C., gave an important judgment bearing on the position between master and servant. It was a case in which John Edward Stephenson, formerly tram conductor in the service of the Colne and Trawden Light Railway, sued the company for £2 14s. 6d., which the plaintiff claimed he was entitled to in respect of wages and alleged illegal deductions.

According to plaintiff's story he lost 500 1d. tram tickets, and the company deducted the face value of them from his wages, although it was contended the actual damage was purely a nominal one. On October 17th plaintiff's wages were as low as 1s. 8d. for the whole week.

The defence was that the money was stopped from Stephenson's wages from July 1st last for shortages in his cash.

His Honour, in delivering judgment for the plaintiff, said the law enacted that the employer shall at the time of working a contract give a fair copy of it to the workman or a notice containing its terms. There must be judgment for the plaintiff for the sum claimed with costs, although he thought that plaintiff's conduct had been such that he might very properly have not allowed any costs.

BUSINESS NOTES.

Consular Notes.—JAPAN.—The American Consul at Yokohama reports that with the remarkably rapid expansion of electrical projects in Japan, there has been a still more remarkable advance in the practical proficiency of the plants that manufacture electrical appliances. At first the electrical business was confined to providing light and power for electric street car lines, but now the electrical manufacturing companies in Japan are becoming very prominent, as well as good dividend-payers in many instances. Two companies of the latter class that attract much attention are the Shibaura Engineering Works at Tokio, and the Tokio Electric Co., Ltd., having extensive and up-to-date electric lamp manufacturing works at Kawasaki, located in the steam and electric railway lines between Tokio and Yokohama. The General Electric Co. of the United States owns 50 per cent. of the lamp works, and nearly a one-third interest in the Shibaura plant, which has a paid-up capital of £278,000. The lamp company's capital is now about £270,000. The lamp plant is credited with turning out the great bulk of all the electric lamps used in Japan, while the Shibaura works manufacture machinery up to from 3,000 to 4,000 KW. size in generators, transformers, motors, &c. Notwithstanding this, about 80 per cent. of all electric motors are still imported, including those of from 500 to 1,000-KW. power. Needless to say, both of these companies have had valuable assistance in the way of technical details and engineering guidance from the American company which is heavily interested in them, and with further advances in proficiency of production the Japanese hope to approach the high standards of the foreign manufacturers of electrical supplies. The hydro-electric companies still buy their heavy machinery abroad. Water-pipes of unusually large size are also purchased abroad, but, on the other hand, Japanese manufacturers in these lines go on cheerfully aspiring to supply their own demands in due course. The business of furnishing electrical power for manufacturing plants in Japan is also comparatively new. It is now roughly estimated that the electrical plants of all kinds in Japan represent about £56,000,000, including capital stock. The paid-up capital stock, compared with the total capital stock, of the following enterprises, is estimated as follows:—

	Stock.	*Paid up.*
Electric lighting companies	£14,000,000	£10,000,000
Electric lighting and railway companies ...	16,000,000	14,000,000
Electric railway companies...	2,000,000	1,400,000

Ten years ago the electrical properties of Japan were estimated to represent only about £2,800,000. During the above period the kilowatt power produced in Japan advanced from less than 45,000 to over 345,000, the number of miles of electric wire from less than 10,000 to over 35,000, and electric railway mileage from less than 100 to over 700.

INDIA.—The German Consul in Bombay reports that in the year 1912 electrical machines were imported into India to the value of 3,613,000 rupees. As far as power machinery is concerned, electrical machinery for use in connection with water-power plants has the best future. There are at present in the country two large works of this nature, the one on the Cauvery Falls, in the Southern province of Mysore, from which transmissions have been carried to the Kolar goldfields and the towns of Mysore and Bangalore, and the Tata hydro-electric works in Lanauli, near Bombay, which is to supply power for 900,000 spindles and 7,500 looms in Bombay. The total number of electric plants in India is already large, and is increasing. All the larger towns either already possess electrical works for lighting and tramways, or are in train to establish such. Consequently the use of electricity may fairly be said to be only in its initial stage, and one may therefore confidently anticipate a gradually increasing market for electrical machinery. There is no Indian machinery industry, and everything that works require of this character must be imported. The greater part of the trade—in fact, about 90 per cent.—is now supplied from the United Kingdom, whilst Germany and the United States follow a long way in the rear. The reasons for this are said by the Consul to be various. On the one hand, the machinery import trade is almost exclusively in the hands of British houses, who naturally maintain their connection with the United Kingdom. On the other hand, many machines are not bought in India, through the British merchant houses, owners of factories journeying themselves to Europe and giving orders at the works. As the English in India, as well as the natives, rarely know any other European language than English, however, it naturally follows that they most frequently place their orders in Great Britain. Moreover, habit is a powerful factor. Machinery and appliances have for so long been procured in England, that buyers are difficult to convert to the opinion that, in the view of the German Consul, they can buy just as well, and just as cheaply, in Germany. The chief reason for the meagre German business in machinery in India is that German firms have taken little trouble to push their goods in the market. The handing over of representation to any importing house is not sufficient. The cultivation of the demand for any particular firm's machinery requires much work which an importing firm is, as a rule, neither willing nor energetic enough to undertake. Moreover, the occasional visit of a commercial traveller will not suffice, as the connection which he may establish with the importers can neither be strong enough, nor of a lasting description. More success will attend the system of attaching to the importing house to which representation may be given a technical agent from the works, who will have nothing else to do but nurse the market, while the importer does the shipping and financial part of the business. The impression seems to prevail that the Indian manufacturer will be prepared to purchase machinery from a catalogue or description, whereas, in fact, he is much more likely to do so if it is possible for him to see the machine itself, or better, to have an opportunity of seeing it in working. English firms with this end in view have in some instances established warehouses in India, with technical men at their head. This procedure is naturally expensive, but it is found in time to repay the cost. Up to the present, however, German firms have not followed this example, which they might well take into consideration.

SOUTH-EAST ASIA.—The American Consul at Hong-Kong reports that development of wireless telegraph communication along the South-East Coast of Asia is slowly proceeding, though it is far from being as advanced and as satisfactory as has been expected. Early in December the wireless installation under construction in British North Borneo was put into operation to some extent, and communication was established with the Philippines. At present the service lies between Sandakan and Malabang, where a de Forest installation has been in operation for about seven years. The communication from Malabang to Manila is by landlines. The second station in North Borneo was being completed, at the time of writing, at Jesselton, the two stations named being stations in a complete system which is being established by the British North Borneo Co. Wireless installation in Hong Kong has not yet materialised despite the fact that the acturial budgets for 1912 and for 1913 each appropriated about £10,000 therefor, and this, too, independently of the plans of the British Government for a comprehensive system of wireless communication for the Colonies. The actual purchase and installation of the proposed low power plant, according to information given by the Colonial Government, lies with the Crown Agents in London. Questions of defence and military exigency are mixed up with other elements in the situation, so that it is not easy to give any date for the installation of a wireless service, though the business community of this, the largest commercial port in the East, and especially the shipping interests in this great shipping port, are insistently demanding wireless service. In China wireless telegraphy is receiving considerable attention, though, as a rule, the service given is not very satisfactory. Some 12 stations are operated, or are supposed to be operated, in various parts of the Kwangtung and Kwangsi Provinces, and the Chinese Government has planned extensions of wireless service all over the country, including a service to Tibet and the so-called New Territory. A contract was made over a year ago for establishing a complete system of high power station from Peking and Kalgan to Shanghai, Canton and all provincial capitals and also on the Pratas Island shoals about 200 miles south of Hong Kong, but for financial and other reasons the actual work has not yet been begun, and it is uncertain just when the systems will actually be established. The work of installing the powerful Telefunken stations in Siam begun a year ago has progressed satisfactorily. The principal station is at Klong Toi, near Bangkok, where a most substantial installation has been made for the maintenance of a day and night service with Singora and points as far as Sabang.

For Sale.—At Manchester on May 7th, MESSRS. PERCY HUDDLESTON & CO. will sell, by public auction, a large quantity of electrical apparatus, &c., particulars of which are given in our advertisement pages.

Catalogues and Lists.—THE GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, London, E.C.—Eight-page price list of special types of Osram drawn-wire lamps for medical and scientific purposes.

MESSRS. VERITYS, LTD., 31, King Street, Covent Garden, London, W.C.—Publication No. 766, giving illustrations and fully tabulated prices of "Aston" knife switches, circuit breakers, fuses and distribution boards.

MESSRS. SLOAN ELECTRICAL CO., LTD., 12, Golden Lane, London, E.C.—Folder card, giving particulars and prices of Conradty's carbon brushes.

THE HART MANUFACTURING CO., 76 and 77, Rochester Row, Westminster, London, S.W.—Eight-page list, containing a full description of their "Diamond H" remote-control switches; wiring diagrams, mounting and drilling dimensions, and prices are given.

MESSRS. DRAKE & GORHAM, LTD., 1, Felix Street, Westminster Bridge Road, London, S.E.—Illustrated and priced pamphlet No. 22, showing their electric cooker and stove, and a few of its uses.

MESSRS. RICHARD JOHNSON & NEPHEW, LTD., Bradford Ironworks, Manchester.—Pamphlet of about 50 pages entitled "Wire: A useful handbook for buyers and users," giving very full information respecting their telegraph and telephone wires—galvanised iron and steel—fencing and barb and other wires. A number of handy wire gauge, breaking strain, and other tables are included.

MESSRS. BENJAMIN ELECTRIC, LTD., 1A, Rosebery Avenue, London, E.C.—Section lists Nos. 55 and 56, giving illustrated and price information respecting the Dean design battery horn which they are putting on the market for motor-car and motor-cycle service. The motor-car horns are made in four models operating on from 5 to 10 volts; model "C" for motor-cycle use operates on 4 to 6 volts. We understand that these horns have already been standardised for 17 different makes of light motor-cars in America.

THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—Price list No. 2,220 (eight pages) contains an illustrated description of the firm's battery charging generators (0·22-2·52 KW.), with tables of prices, &c., for 50-70 volts and 100-140 volts.

Allgemeine Elektricitats-Gesellschaft, Berlin.—Brochure describing insulation resistance measuring instruments for use with alternating current.

The Westinghouse Brake Co., Ltd., 82, York Road, King's Cross, London, N.—Publication No. M414 of 64 pages, excellently illustrated, containing very full information describing their silent rocker-joint chain drives, their design, cost, installation and maintenance.

The St. Helens Cable and Rubber Co., Ltd, Warrington.—Booklet dealing with "cab tire sheathed" cables for wiring work. This type of cable has been adopted for electric vehicles by the I.M.E.A. Committee, and is here put forward for use in general installation work; the wires may be run on or under plaster, and it is claimed that the wiring is cheap, gives no trouble, and is practically everlasting. Ordinary fittings may be used with it, and single, twin (round or flat), and three-core flat cables are listed, as well as small flexible cords for portable lamps, &c. A special corrosion-proof junction-box for use in corrosive surroundings has been devised for use with C.T.S. wire.

Bankruptcy Proceedings.—Tom Murray Woodcock, electrical engineer, 64, Holly Street, Sheffield, York.—The public examination of this debtor was held last week at the County Court Hall, Bank Street, Sheffield. It appeared that he commenced business in February, 1913, having no capital. Debtor admitted that he had lost about £3 weekly, but stated that he was not aware of this whilst he was trading. His turnover for the 12 months was about £370, and his deficiency was estimated at £153. The failure was attributed to inability to buy cheaply on account of lack of capital, losses on contracts and heavy business expenses. Debtor commenced to trade with the General Electric Supply Co. in October last, and he now owed them £74. He had not paid this company anything in respect of the goods which they had supplied. In reply to further questions, debtor said he had tried to find out his position, but had been unable to do so. The case was declared closed.

W. H. Pease, electrical engineer, residing at 19, Princess Royal Terrace, Scarborough, lately carrying on business at Royal Hotel Shops, Scarborough, and at Doncaster.—A statement of affairs has been issued in the above-mentioned case, which discloses liabilities to unsecured creditors amounting to £771, and to secured creditors £5, making a total of £776. The assets are estimated to produce £256, and there is a deficiency of £525. The debtor, who is 23 years of age, was engaged as an electrical engineer for 12 months prior to January, 1912, when he commenced business on his own account. He had a capital of £21, and worked under contract. In March, 1914, he opened out at Harcourt Place, Scarborough, taking with him from Doncaster about £100 worth of stock. At that time he was being pressed by creditors, and, in order to meet his payments, he resorted to borrowing money from relatives and friends, and had also obtained £56 from money-lenders. He attributed his failure to bad health and loss on contracts. The first meeting of creditors was held at Sheffield on Tuesday. The Official Receiver remains trustee.

Dissolutions and Liquidations. — The Canadian Power Tramways Construction Syndicate, Ltd.—A meeting will be held at 3, Princes Street, E.C., on May 29th, to hear an account of the winding up from the liquidator, Mr. H. G. Clarke.

Telephos, Ltd.—A meeting will be held at Gresham House, E.C., on May 26th, to hear an account of the winding up from the liquidator, Mr. M. A. Carson.

Tricket & Co., electrical and general engineers, gas fitters and garage keepers, Norwood, S.E.—Messrs. F. J. Tricket and C. G. Stevens have dissolved partnership. Mr. Tricket will attend to debts.

The Steam Fittings Co., Ltd.—This company is winding up voluntarily with Mr. W. Jaegermann, of 3, Melbourne Avenue, Ealing, as liquidator. A meeting of creditors is called for May 11th; claims must be sent to the liquidator by May 30th.

Vesey Brown & Hall, consulting electrical engineers, Milburn House, Newcastle-on-Tyne.—Messrs. C. S. Vesey Brown and W. Hall have dissolved partnership as from December 31st, 1912.

The Universal Cable Code (Parent) Co., Ltd., 22, Henrietta Street, W.C.—First meetings of creditors and contributories May 12th at 33, Carey Street, W.C.

Fire.—Early on Monday morning a disastrous fire broke out at the works of Messrs. Hurst, Nelson & Co., at Motherwell. In addition to damage to the works building, throwing 300 men out of work, 25 tramcars and a number of railway coaches were destroyed. It is said that the loss is £100,000.

Book Notices.—"Advertising and Progress." By E. S. Hole and John Hart. London: *Review of Reviews* Office. Price 5s. net.

"An Elementary Treatise on the Calculus for Engineering Students." By John Graham. London: E. & F. N. Spon, Ltd. Price 5s. net.

"*Proceedings* of the Physical Society of London." Vol. XXVI, Part III. April. London: *Electrician* Printing and Publishing Co., Ltd. Price 4s. net.

"*Journal* of the Western Society of Engineers." Vol. XIX, No. 2. February. Chicago: The Society. Price 50 cents.

"*Giornale* ed Atti della Associazione Elettrotecnica Italiana." Vol. I, No. 9. April 25th. Milan: The Association. Price L. 1.

Trade Announcements. — The Langdon-Davies Motor Co. announce that their new telephone number is "City 2744" (two lines); their works telephone is unaltered.

Messrs. E. G. Appleby & Co. have removed to more extensive premises at 12, The Broadway, Westminster, S.W. New Telephone No. "Victoria 6503."

Messrs. Nalder Bros. & Thompson, Ltd., have recently removed to larger premises at 97A, Dalston Lane, N.E. (telephone Nos, Dalston 2365 and 2366; telegraphic address, "Occlude Kinland London"). The works are five minutes' walk distant from Dalston Junction and Hackney Downs stations. The City office and showroom at 34, Queen Street, is being retained, with a private telephone extension line connection to the works. The "parts" works premises at Kingsland Green are likewise connected by a private extension line. The extended works and additional manufacturing facilities now available will enable the firm to give more expeditious execution of contracts.

LIGHTING and POWER NOTES.

Accrington.—L.G.B. Inquiry.—On Wednesday last week Mr. H. R. Hooper held an unopposed inquiry into the application of the T.C. to borrow £33,530 for extensions to its E.L. undertaking, including £28,000 for plant and £5,000 for buildings.

Armagh.—Proposed E.L.—The U.D.C. is considering the question of lighting the town with electricity.

Bexhill.—The Corporation has decided to extend the feeder cables, to lay distributor cables, and to install a booster at the electricity works for the purpose of increasing the pressure of supply at Little Common and Cooden Beach. The estimated cost is £2,500, and the scheme will defer the erection of a sub-station for three or four years.

Blackburn.—Year's Working.—For the past year the T.C. electricity department has yielded a net profit of £5,000, of which £4,410 has been placed to the renewals and extensions fund. The income was £48,400, and the expenditure £24,217.

Blackpool.—Year's Working.—The income of the electricity department for the past year amounted to £44,997, against £40,333 in the previous year. The expenditure was £23,562, against £20,928, and the gross balance is £21,435, of which £13,972 is absorbed by interest and sinking fund charges. The net surplus is £7,463, against £6,226. £4,000 has been placed to the relief of rates and £3,500 to the renewals fund.

The Corporation has decided that electrical illuminations shall form a special feature of the next autumn season, and, in order to obtain ideas, a Corporation official was to visit Paris last week.

Bristol.—Exhibition Lighting Scheme.—In connection with the Bristol International Exhibition, which opens on May 28th, an extensive scheme of electric lighting has been devised. The Corporation electricity department is laying 6,000-volt cables over the 2½ miles between its power station and Ashton Gate, to feed a sub-station in which will be installed nine static transformers, giving a supply at 365 volts for power and 210 volts for lighting. The Exhibition supply will permanently benefit a large section of the city supply; the authorities have guaranteed to use some £6,000 worth of energy, and the electricity department is spending about £8,000 in cables, &c. The illumination scheme includes the outlining of the various pavilions, the lighting of the grounds, and various spectacular features.

Castlerea (Co. Mayo).—Proposed E.L.—The D.C. has applied to the L.G.B. for sanction to a loan of £1,263 for the installation of an E.L. plant at Ballaghaderreen town.

Chester.—Street Lighting and New Mains.—The Electricity Committee has recommended that the 103 remaining arc lamps, and 20 incandescent lamps be replaced by metal-filament lamps, at an estimated cost of £545; it was stated that the current consumption would be about halved. The Committee also recommended that new cables be laid, at an estimated cost of £3,282, to be charged to the reserve fund and spread over three years.

Clogheen (Munster).—Proposed Workhouse Lighting.—In connection with the proposed E.L. scheme, the B. of G. has appointed a committee to consider the E.L. of the workhouse, at a cost of about £150.

Clonmel (Co. Tipperary).—Asylum Lighting.—At a meeting of the Committee of the Clonmel District Lunatic Asylum, the medical superintendent stated that with the new E.L. plant the cost per light worked out at 9s. 5d., whereas gas cost 18s. 10d. per light; they also obtained three times as much light with electricity, and other advantages were the absence of the blackening of walls and coolness in summer.

Continental Notes.—Germany.—Last autumn a new municipal dock was opened in Berlin, and already the very complete modern electrical equipment has attracted such a large volume of new traffic that extensions of the silos and cranes are proposed.

The Waldeck Dam, which is being built by the Prussian Government, will probably be opened this year by the Emperor. As it will hold 202 million cb. m. of water, and will be 42 m. high, it will be the largest dam in Europe, though not in the world. Its primary purpose is the regulation of rivers, but the power will be utilised on a large scale. The plant will be coupled electrically with the water-power stations at the Diemeltal and Münden Dams, and will distribute energy over a wide area.

The issue of bonds to the amount of £250,000 by the Stade Elektrizitäts Verband for the construction of a network of high-pressure electrical mains has received Ministerial sanction.

A co-operative electric supply association has been formed at Felstedt, Schleswig-Holstein, to provide that town and the neighbouring districts with electricity.

The Landtag of Pomerania has approved of the expenditure of £250,000 for the construction of a bulk electric supply station at Stettin.

The A.E.G., of Berlin, intends to construct a station at Kalau, in Brandenberg, for the supply of electricity in bulk to the districts of Spremberg, Kalau and Luckau.

SPAIN.—A correspondent of the *Financial Times* writing on the subject of hydro-electric power developments in the neighbourhood of Barcelona, points out that at Pobla a 4,000-H.P plant has been completed; nearby, at Talarn, the development of 96,000 H.P. is being carried out, and should be completed this year. At Lerida another 56,000-H.P. plant is practically completed. To the south of Seros a scheme is in hand for developing 300,000 H.P. on the Ebro, and a contract is stated to have been entered into with a Swedish Co. to supply 75,000 KW. to a nitrogen extraction works, from this source. All these concerns are controlled by the Barcelona Traction Co. (a Canadian concern), and it is stated that the company has never yet been able to overtake the demands of its customers. The company controls the 65,000-H.P. steam plant of the Barcelona Electricity Co., which it is intended to hold as a stand-by, when hydro-electric energy is available. The company has in hand some 50,000 contracts for 103,000 H.P., and it is estimated that a further 50,000 H.P. can be contracted for when power is available, while other contracts in view comprise 32,000 H.P. The power is mostly used in the cotton and worsted industries, and the company has an arrangement with its only serious competitor, the Electric Energy Co., of Catalonia.

NORWAY.—It is reported from Stavenger that the A/S Sandefaldene has entered into a contract with the Union Carbide Co., of New York, to supply the latter with 40,000 H.P. within four years from 1916, and with additional power after if required. The Carbide Co. already operates four American works, and it is anticipated that the carbide products from the new factory will be shipped to America. The Orsten (Romsdal) and the Arkedalin municipal authorities are both embarking on small hydro-electric schemes.

BULGARIA.—A scheme for establishing a central station for the electric lighting of the towns of Kritschin and Philipopolis is under consideration.

SWITZERLAND.—The Grand Council of Zurich has sanctioned a credit of £49,200 for the construction of an electric lighting and transformer station in that city.

Coventry.—PROPOSED MAINS EXTENSIONS.—The E.L. Committee is considering the question of extending the E.L. mains to Stoke Church.

Dalbeattie.—PROPOSED E.L.—The T.C. has received a communication from an Edinburgh firm on the subject of an E.L. scheme for the town; the letter has been remitted to the Lighting Committee for report.

Dalkey.—E.L. BILL.—The U.D.C. has appointed a Committee to oppose the Gas Co.'s Electric Supply Bill.

Dunoon.—NEW E.L. PLANT.—The T.C. has decided to install new plant, at a cost of £444, to provide for the E.L. of the pier, pavilion and Castle Gardens.

Flint.—E.L. SCHEME.—The T.C. has decided to undertake an E.L. scheme, the cost of which is estimated at £6,000.

Golcar.—PROPOSED BULK SUPPLY.—In response to a letter from the U.D.C., the Huddersfield Electricity Committee is considering the question of supplying electricity in bulk to the area controlled by the U.D.C.

Gravesend.— LOAN SANCTION.—The T.C. has received sanction to a loan of £13,150 for electricity purposes.

Haltwhistle (Northumberland).—PROPOSED E.L.—The P.C. has adopted a resolution requesting it to purchase a refuse destructor plant and electrical equipment for electric lighting in the district.

Ilkley.—L.G.B. INQUIRY.—An inquiry was held on Tuesday, by Mr. T. C. Ekin, into the application by the U.D.C. for sanction to borrow £18,000 for electricity purposes in Ilkley and Myddleton, including the erection of a generating station at Ilkley. A number of property owners objected to the site of the generating station.

India.—The Dewan has directed that, as from the 1st inst., the charges in the assigned tract (civil and military station), Bangalore, are to be on exactly the same basis as in the city, which will represent a cheapening all round in the station by as much as 25 per cent. It is also understood that these rates will be still further reduced next year.

Inverurie.—PROPOSED E.L.—The T.C. has appointed Messrs. James E. Sayers & Caldwell, of Glasgow, to report on the various E.L. schemes for the town.

Keighley.—EXTENSION OF SUPPLY AREA.—In connection with the proposed supply of electricity by the T.C. to Morton, the Council suggested that inquiries should be made at East Morton, and asked the Keighley R.D.C. whether it would approve of the T.C. seeking powers to supply electricity in Steeton-with-Eastburn and Sutton. The R.D.C. has consented to the T.C. making inquiries at Morton Banks, further consideration of the matter being deferred for one month.

Loughrea (Co. Galway).—The Town Commissioners have accepted the offer of the local E.L. Co. for electric lighting in the town.

Lytham.—BULK SUPPLY.—The terms to which the U.D.C. has agreed for the supply of electricity in bulk from the St. Anne's U.D.C. are as follow:—Up to 100 KW., £5 per KW.; between 100 and 200 KW., £4 per KW.; between 200 and 300 KW., £3 10s. per KW.; between 300 and 400 KW., £3 per KW.; plus ½d. per unit up to 200,000 units and ·4d. over 200,000 units. The St. Anne's Council is to pay Lytham 10 per cent. of the gross receipts from the Tramway Co. for the supply of current in Lytham after June 1st, 1917. The agreement is to be for 10 years, and the above charges are subject to revision at the end of five years. The St. Anne's Council is to withdraw its opposition to Clause 41 of the St. Anne's Improvement Bill.

The application of the U.D.C. for sanction to borrow £23,700 for electricity purposes formed the subject of an inquiry last week.

Manchester.—YEAR'S WORKING.—The income of the electricity department for the past year increased by £36,125 over the previous year, and the net surplus increased from £28,331 to £36,370. The units sold increased from 104 millions to 117 millions.

For the forthcoming year the Committee estimates for the sale of 130 million units, an income of £552,800, and a surplus of £30,500, of which £30,000 is earmarked for the relief of rates, according to arrangement.

Middlesbrough.—NEW MAINS.—The Electricity Committee has decided to expend £3,250 on new electric cables.

Preston.—PROPOSED NEW PLANT.—The T.C. has appointed a Committee to consider the necessity for provision being made for an increased output of electricity.

Rawtenstall.—YEAR'S WORKING.—The accounts of the Electricity Department for the past year show that the income increased by £2 915 compared with the previous year, and the surplus is £2,481. The output increased by nearly a million units. The total cost of production was ·64d. per unit. The new turbo-alternator is expected to be ready this month, and further extensions are contemplated.

Ripley.—PROV. ORDER.—The B. of T. has refused the application of the U.D.C. that the maximum charge named in the prov. order applied for by the E.L. Co. should be under 6d. per unit. The clause empowering the company to supply fittings has been deleted, and the Council has now dropped its opposition to the order.

Roundhay.—The B. of T. has authorised the Leeds T.C. to supply electricity in Roundhay.

Skipton.—It has been reported to the U.D.C. that the electricity plant is insufficient to supply the Co-operative Society's new premises in Swadford Street, and the matter is to be considered next month.

Southend-on-Sea.—STREET LIGHTING.—The T.C. proposes to light the new promenade, from the Palmeria Arches to the Pier, with 20 2,600-C.P. arc lamps, at a charge of £13 14s. each per annum, and to light the Broadway with 10 new arc lamps of a total capacity of 32,500 C.P.

Wallsend. — An extensive electrification scheme is being carried out at the Wallsend and Hebburn mines of the Wallsend and Hebburn Coal Co., at a total cost of about £200,000, under the superintendence of Mr. C. A. Nelson, formerly of the Silkstone Collieries, Yorkshire. The whole of the steam plant has been removed and modern electrical plant has been installed by the British Westinghouse Co. Two years ago 3,000 men and boys were employed by the company, but when all the pits are in full working order it is estimated that about 7,500 will be employed.

West Ham.—STREET LIGHTING.—The Highways Committee has recommended that the tender of the electrical engineer be accepted for alterations and improvements to the street lighting on tramway routes, as follows:—Replacement of present arc lamps with 200-watt incandescent lamps on each pole, including lighting and maintenance, at £3 10s. per lamp per annum, and with lanterns containing four 100-watt lamps, at £7 per lantern per annum; the installation of modern swan-neck fittings, with 100-C.P. lamps, in place of existing electric lamps, including lighting and maintenance, at £2 12s. 6d. per lamp per annum; and the conversion of about 200 gas lamps to 100-C.P. incandescent electric lamps, at £2 12s. 6d. per lamp per annum.

TRAMWAY and RAILWAY NOTES.

Barnes.—ELECTRIC VEHICLES.—The surveyor to the U.D.C. has reported to the Council in favour of displacing horse-drawn vehicles for refuse collection by battery-driven vehicles, carrying a ton of refuse, and costing £520 each. He estimates that five such vehicles would replace 10 horsed vans, with a saving of £200 per annum. Consideration of the matter is being delayed until the Committee can see a vehicle of the kind in use.

Blackburn.—YEAR'S WORKING.—The T.C. tramways undertaking shows a profit for the past year of £4,011, compared with £3,870 in the previous year; the receipts were £71,338, and the working expenses were £24,168.

Blackpool.—YEAR'S WORKING.—The income of the T.C. tramways for the past year was £84,797, as against £74,166 in the previous year. The gross profit was £41,310, compared with £34,484, and the disposable surplus is £24,522, as against £18,331 last year; £12,000 is to go to the relief of the rates, and the balance to the renewals fund.

Birmingham.—ELECTRICAL VEHICLES.—According to the *Surveyor*, the electricity department has undertaken to supply the Refuse Disposal Committee with two battery-driven vans for removing street refuse, at a cost of £550 each.

Castleford.—The Yorkshire (W.R.) Tramways Co. proposes to double the tramway track in Cambridge Street.

Continental Notes.—GERMANY.—The rolling stock design for the Berlin railways is being very carefully investigated, and a number of experimental trains are being tried. For the new municipal underground railway the London and Paris types of coach are being copied, and separate entrances and exits will be provided.

The Prussian State Railways has ordered experimental rolling stock for the City and Ring Railway from the Maffet-Schwartzkopffwerke, Siemens-Schuckert, A.E.G., Bergmann and Brown-Boveri firms, and has commenced trials of one complete train on its Dessau-Bitterfeld line. This train of 12 coaches can be split into two sections, and is stated to have only two four-wheel motor-bogies; separate compartments, with a narrow side corridor, are likely to be adhered to.

The Göttingen T.C. has decided to construct a tramway system.

The Rhenische Schuckert Gesellschaft has been granted a concession for the construction of an electric railway between Bensheim and Lindenfels, in Hesse.

SWEDEN.—The Mellerster Oester-Gottland Railway Co. has decided to electrify its system to the west of Linkoping, the current to be supplied from the Naas power station on the River Motala.

FRANCE.—A new company has been formed at Douai, with a capital of £20,000, entitled La Compagnie du Tramway Electrique à Voie Etroite de Douai a Lallaing, to construct and work an electric tramway between the two towns named.

Dundee.—RAILLESS TRACTION.—The Tramways Committee has agreed to discontinue the railless traction system in Clepington Road.

Golcar (near Huddersfield).—The question of a motor-'bus service having again been introduced, the U.D.C. has appointed a sub-committee to consider the provision of some means of passenger transit for the district.

Halifax.—PROPOSED EXTENSIONS.—The Tramways Committee is to hold a special meeting to consider the suggested tramway extensions from Brighouse to Rastrick and on to the Huddersfield boundary, and from Halifax to Elland.

Rawtenstall.—During the past year £1,500 has been taken from the rates for the relief of the tramways undertaking, £622 of which was placed to the credit of the renewals fund, and £878 to balance of loss on the year's working.

Stirling.—PROPOSED TRAMWAYS.—The T.C. has agreed to hold a conference with representatives of the County Council, the Bridge of Allan T.C., and the Stirling and Bridge of Allan Tramways Co., to consider a proposal for electric tramways.

TELEGRAPH and TELEPHONE NOTES.

Australia.—The Post and Telegraph Department has drawn up a plan of work to be carried out during the next three years, involving an expenditure on telephone equipment of about £4,000,000, of which Sydney will receive about 1½ millions and Melbourne £600,000. Three automatic telephone exchanges have been erected in Sydney, and none in Melbourne.

Imperial Wireless System.—The Select Committee of the House of Lords, which has been inquiring into the charges against Lord Murray, has this week been discussing the chairman's draft report in private.

Morocco.—Notice is given in the *London Gazette* of new rates for telegrams to Morocco, ranging from 3d. to 6½d., according to destination.

Post Office Employés.—A return has been issued showing the changes in the wages and conditions of service of Post Office employés in connection with the reports of the Select Committees on Post Office Servants, 1907 and 1913.

Strike.—A number of labourers employed in the extension of the underground telegraph cables in Dublin went on strike on Saturday last, because their demand for an additional ½d. per hour in wages was refused.

Telegraph Conference.—An International Conference of Telegraph Engineers is to be held in Berne from September 14th to 20th next. Among the subjects to be discussed are: "The Prospects of Telephony over Longer Distances," "The Protection of Telegraph and Telephone Wires from other Electrical Conductors," and "How Far Automatic Apparatus in Telephone Exchange Working is Desirable."

The Telephone Service.—Captain Norton furnished the following information in reply to a question in the House of Commons:—

Total new telephones provided during the year 1913:—

London	31,000	Edinburgh	1,818
Birmingham	3,161	Belfast	981
Liverpool	3,057	Dublin	1,267
Manchester	4,131		
Glasgow...	3,033	Total	48,448

Applications in hand:—

	One month old or less.	Over 1 but not more than 3 months old.	More than three months old.	Total.
London ...	1,105	322	223	1,650
Birmingham ...	208	151	246	605
Liverpool ...	94	20	35	149
Manchester ...	166	90	86	342
Glasgow ...	122	41	3	166
Edinburgh ...	69	16	93	178
Belfast ...	49	32	52	133
Dublin... ...	34	54	62	150
	1,847	726	800	3,373

Reasons for applications delayed over three months:—Subscribers not yet ready for work to be proceeded with, 104; cases in which wayleave difficulties have arisen, 99; applications in connection with new exchanges not yet opened, 136; waiting for the extension of underground and other main plant, 273; long lines in ordinary course of completion, 93; various other causes of delay, 95; total, 800.

At the annual meeting of the London Chamber of Commerce last week, Lord Southwark said that a special Telephone Committee had been formed on which that Chamber, the L.C.C., the City Corporation, the Port of London Authority, the Home and Foreign Produce Exchange and other bodies were represented, to deal with telephone matters.

Messrs. Johnson & Phillips, Ltd., who secured the order for manufacturing and laying a new trunk telephone cable between Swansea and Llanelly, will shortly commence the work of drawing-in.

Time-Signals for Explorers.—The German Orinoco Expedition will carry wireless receivers to detect the time signals from the stations on the Amazon and in North America. These will serve to correct the chronometers.

Wireless Telegraphy.—Duke Ernst II., of Sachsen-Altenburg, has for years taken a great interest in wireless telegraphy, and is having an installation erected on his Castle in Altenburg for communication with air-craft. On April 4th he caused a lecture to be delivered there before a large company of persons interested in the subject. The lecturer was Herr Bredow director of the Telefunken Co., and by the aid of an experimental installation, he read messages of greeting from Norddeich and Nauen. Those from Norddeich were in Morse code, but those from Nauen were telephonic, *i.e.*, the words were spoken and not telegraphed.

CONTRACTS OPEN and CLOSED.

OPEN.

Ashton-in-Makerfield.—May 11th. D.C. overhead transmission line, with switchboards and internal wiring for power and lighting, for the sewage disposal works. Messrs. Banks, Fairclough & Stephen, civil engineers, Leigh.

Australia.—May 26th. Adelaide Tramways Trust. Overhead tramway equipment and construction. Board of Trade Commercial Intelligence Department in London.

May 20th. Victorian Railways Commissioners. One three-phase slip-ring electric motor and accessories. Deposit £1. Local representation. A specification can be seen at the B. of T. Commercial Intelligence Department in London.

SYDNEY.—July 20th. Box compound, meters, maximum-demand indicators, arc lamp carbons, and straight-stem insulators, for the Council. Specifications for each section 10s. 6d., from City Electrical Engineer, Town Hall.

MELBOURNE.—May 20th. 1,132,000 arc lamp carbons, for City Council. See "Official Notices" to-day.

Belgium.—May 9th. The municipal authorities of Montegnée (Province of Liége) are inviting offers for the concession for the electric lighting of, and power supply in, the town. The contract is being offered in two ways, one of which provides for the establishment of a central station, as well as a network of distribution mains in the town, and the other for the mains only, the current being supplied from an already existing power station.

BRUSSELS.—May 6th. Tenders for the supply and erection of telephone and telegraph cables. Deposit, 10,000 fr. Cahier des Charges Spécial No. 217. Salle de la Madeleine, Brussels.

Bridgend.—May 6th. Glamorgan County Asylum. Electrically-driven lift for cold store. See "Official Notices" April 24th.

Buxton.—Electric wiring work, Grosvenor Private Hotel. Mr. P. J. Maddock, Newlyn, Moreton (Cheshire).

Derby.—Corporation. Twelve months' supply of steam coal, for the electricity department. Particulars from the Borough Electrical Engineer.

Devonport.—May 12th. Steam coal (5,000 tons) for a year, and general engine-room stores, for the Corporation Electricity Department. Mr. J. W. Spark, Borough Electrical Engineer, Newport Street, East Stonehouse.

Dundalk.—May 11th. U.D.C. Diesel generating plant, balancer and booster, motor generator, switchboards, battery, mains, crane, oil pipe line and storage tank. See "Official Notices" April 24th.

Edinburgh.—May 6th. Corporation. Twelve months' supply of lead-covered, paper-insulated cables, for the Electricity Department. Specification from Mr. F. A. Newington, Engineer, Electricity Supply Station, Dewar Place.

Germany.—May 13th. The Lighting and Water authorities of the City of Bremen are inviting tenders for a 40-KW. asynchronous transformer for converting alternating to continuous current.

Hoylake and West Kirby.—May 8th. Coal for a year for the U.D.C. E.L. works (about 3,500 tons washed peas). Mr. Chas. J. Turner. Electrical Engineer, Hoylake.

May 11th. U.D.C. Ornamental iron transformer station. See "Official Notices" to-day.

Ilkley.—May 11th. U.D.C. Electricity generating station buildings. See "Official Notices" April 17th.

Leeds.—May 11th. Corporation. Steam turbine, three-phase alternator and exciter, 12,000 KW., 1,000 to 1,500 R.P.M., and condensing plant. See "Official Notices" April 3rd.

London.—May 6th. Metropolitan Asylums Board. (1) Electric light installation at Grove Fever Hospital; (2) rewiring fire alarm and telephones, &c., at Southern (Lower) Fever Hospital; (3) milk Pasteurising and motor-driven plant for Eastern Fever Hospital. See two "Official Notices" April 24th.

Manchester.—May 13th. Corporation. 5,000-KW. turbo-alternator complete. See "Official Notices" April 17th.

Oldham.—May 4th. Electricity Committee. Steam coal for six months, commencing May. Mr. S. W. Newington, Electricity Offices.

Sheffield.—May 2nd. B. of G. Installation of telephone and fire-alarm system at the Workhouse, for the Guardians, Ecclesall Bierlow Union. Specification from the Clerk, Union Offices, The Edge, Sheffield.

South Shields.—May 9th. Stores, &c., Tramways Department for 12 months. Mr. W. T. Robson, Tramways Manager, Dean Road.

Spain.—May 15th. The Tarragona Provincial Tramways Co., of Tarragona, is inviting tenders for the construction of an electric tramway between Reuss and Tarragona.

Swansea.—May 4th. Electric lighting, new building, Rhyddings Congregational Church. Specifications from the Clerk of Works on the site.

Warrington.—May 12th. Extra-high and medium-pressure paper cables, for electricity department. See "Official Notices" April 24th.

West Ham.—May 16th. Corporation. For 15 double-deck bogie tramcars and one four-wheel single-truck double-deck tramcar. Specifications from Mr. J. S. D. Moffet, Tramways Manager, Greengate Street, Plaistow, E.

Wolverhampton.—May 12th. E.L. installation, Walsall Street Schools, for the T.C. Secretary, Education Offices, Town Hall.

York.—May 12th. Feeder cables for electricity department. See "Official Notices" April 24th.

CLOSED.

Arbroath.—The tender of Messrs. Underhill & Ritchie, Glasgow, has been accepted for the electric lighting of the Parish Church.

Bristol.—The reference in our last issue to a contract for Siemens lamps given out at Bristol was incorrect. For *Bristol* read *Belfast*.

Bury St. Edmunds.—The T.C. has accepted the tender of the D.P. Battery Co., Ltd., for the supply of a storage battery of 252 L21 type cells, complete, for £840, and also their offer to maintain the battery for 10 years (after one year free) for the sum of £83 per annum.

Doncaster.—The Corporation Tramways Committee has provisionally accepted the tender of Messrs. Walter Scott, of Leeds, for the supply of rails for tramway extensions to Warmsworth, for £8,312.

East Ham.—Wiring work. The Town Council proposes to accept the tender of the Ray Electric Co., at £35, for wiring the Boleyn convenience.

Huddersfield.—The T.C. has accepted the tender of the United Electric Car Co. for the supply of 14 new top covers for tramcars.

London.—STEPNEY.—The B.C. Electricity Committee recommends the acceptance of the offer of Messrs. Harrisons (London), Ltd., for a barge-load (175 tons) of Lanark prime quality washed peas, at 13s. 6d. per ton, for trial purposes. For the provision of the steelwork for the foundations for machinery to be installed at the Limehouse station the following tenders were received:—

Dorman Long & Co., Ltd.	(recommended) £372
Redpath, Brown & Co., Ltd.	383
E. Wood & Co., Ltd.	410
J. Westwood & Co., Ltd.	415

SOUTHWARK.—The tender of the General Electric Co., Ltd., is recommended to the Borough Council for acceptance for the supply of four switchboard meters, at £21 each.

Maidstone.—The Kent Insurance Committee has accepted the tender of Messrs. Haynes Bros., Ltd., of Maidstone, for installing the E.L. at new offices in the town, at £25, and for internal telephones, at £46.

Peterborough.—Messrs. Ashton, Frost & Co. have received the contract, at £129, for piping required in connection with the new generating set at the Electricity Works.

Pontypridd.—The following firms have received contracts for the supply of various items to the Electric Light and Tramways Department in the current year:—

Overhead equipment.—Brecknell, Munro & Rogers, Ltd.; Imeson, Finch and Co. (1912), Ltd.; Fleming, Birkby & Goodall, Ltd.; Haslam and Schontheil, Ltd.; Watlington & Co., Ltd.; W. F. Dennis & Co.; B.I. and Helsby Cables, Ltd.

Joint boxes and service boxes.—B.I. & Helsby Cables, Ltd.; W. Lucy and Co, Ltd.; Sykes & Sugden, Ltd.

Insulating material.—L. Andrew & Co.; Baxendale Bros.; British Thomson-Houston Co.; Micanite and Insulators Co., Ltd.; Siemens Bros. & Co., Ltd.; I.R., G.P. and Telegraph Works Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.

Installation stores.—Edison & Swan U.E. Light Co., Ltd.; Veritys, Ltd.; Siemens Bros. Dynamo Works, Ltd.; S. Mansel Jones; Berry, Skinner and Co.; General Electric Co., Ltd.; Baxendale Bros.; Drake and Gorham, Ltd.; British Thomson-Houston Co., Ltd.; I.R., G.P. and T. Works Co., Ltd.; Wandsworth Electrical Manufacturing Co., Ltd.; Accles & Pollock, Ltd.; British Thomson-Houston Co.; Siemens Bros. Dynamo Works, Ltd.; General Electric Co., Ltd.; Cryselco, Ltd.; H. A. Jackson & Co.

Meters, Glass and Globes.—To be purchased by quotation as required.

Cables.—Schedule 1:—Mackintosh Cable Co, Ltd. (subject to satisfactory test. Manager instructed to visit company's works for the purpose.)

Schedules 2 and 3 (Association Cables):—To be purchased by quotation as required.

Schedule 3 (Flexibles):—Callender's Cable Co., Ltd.

Schedule 4:—Liverpool Electric Cable Co.

Insulating material.—Armorduct Manufacturing Co., Ltd.; Brecknell, Munro & Rogers, Ltd.; and British Westinghouse Co., Ltd.

Tramcar equipment.—P. R. Jackson & Co., Ltd.; British Thomson-Houston Co., Ltd.; Morgan Crucible Co., Ltd.; Millar & Co.; British Hele-Shaw Patent Clutch Co., Ltd.; Anti-Attrition Metal Co., Ltd.; Haslam & Schontheil, Ltd.; Fleming, Birkby & Goodall, Ltd.; Equipment and Engineering Co.; and Siemens Bros. & Co., Ltd.

Installation stores.—H. H. Jackson & Co.; E. Dewhurst; Ward & Goldstone; and Metallic Seamless Tube Co., Ltd.

Portugal.—The tenders invited by the General Direction of Public Works and Mines, at Lisbon, for the concession and working of a 12-kilometre electric tramway at Lamego (reported in our "Contracts" column last week), are, it is stated, subject, so far as foreign tenderers are concerned, to the condition that they submit to Portuguese law. A declaration to this effect must be made by them before, and signed by, a Portuguese Consul, and forwarded to the Portuguese Ministry of Foreign Affairs, at Lisbon, for legalisation.

Preston.—The Electrical Apparatus Co., Ltd., has received the contract for the year's supply of D.C. starters to the National Electric Supply Co., of Preston.

Rawtenstall.—The T.C. has accepted the tender of the executors of the late Mr. Joseph Birtwistle, of Waterfoot, for installing the E.L. in connection with the library extensions.

South Africa.—The following tenders have been received in connection with the Ermelo electric light and water schemes for machinery, pumping plant, poles and overhead system :—

Hubert Davies & Co.		£7,750
S. Sykes & Co.		£7,814
Siemens, Ltd.		£7,048
German General Electric Co.		£6,305
British G.E. Co.	(recommended)	£5,961

and the following have been accepted :—

Pipes, £3,000.—Andrew & Thienhaus.
Special castings, valves and fittings, £585.—Stewarts & Lloyds.
Locomobile engine three-throw pumps, poles and cross-arms (manufactured by Stewarts & Lloyds), £6,544.—British General Electric Co.—*South African Mining Journal.*

Southend-on-Sea.—The T.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for two 180-KW. generators for sub-stations at Leigh and Thorpe Bay, at £752.

Southport.—The Tramways Committee recommends that the Tramway Manager be instructed to purchase three toast-rack tramcar bodies from the United Electric Car Co., for £220 each.

West Ham.—The Corporation has accepted the tender of Messrs. Gillespie & Beales for a supply of electrical conduits.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, May 1st. At 8 p.m. At 39, Victoria Street. Paper on "The Control and Organisation of the Engineering Profession," by Mr. S. T. Robson.

Salford Technical and Engineering Association.—Saturday, May 2nd. Visit to Park Works, Newton Heath.

Institution of Electrical Engineers (Newcastle Local Section).—Monday, May 4th. At 7.30 p.m. At Armstrong College. Paper on "Electric Heating and Cooking," by Mr. W. A. Gillott.

Society of Engineers.—Monday, May 4th. At 7.30 p.m. At Institution of Electrical Engineers, Victoria Embankment, W.C. Ordinary Meeting.

Royal Institution of Great Britain.—Monday, May 4th. At 5 p.m. At Albemarle Street, Piccadilly, W. General Meeting.

Rontgen Society.—Tuesday, May 5th. At 8.15 p.m. At Institution of Electrical Engineers. Paper on "X-Rays and Crystals," by Mr. L. W. Bragg.

Institution of Civil Engineers of Ireland.—Wednesday, May 6th. At 8 p.m. At 35, Dawson Street, Dublin. Ordinary meeting.

Chemical Society.—Thursday, May 7th. At 8.30 p.m. At Burlington House, Piccadilly, W. Ordinary meeting.

Iron and Steel Institute.—Thursday and Friday, May 7th and 8th. At Institution of Civil Engineers, Great George Street, S.W. Annual Meeting. Thursday, May 7th. At Connaught Rooms, Great Queen Street, W.C. Annual Dinner.

Physical Society of London.—Friday, May 8th. At 8 p.m. At Imperial College of Science, S.W. Paper on "Gyrostatic Devices for the Control of Moving Bodies," by Dr. J. G. Gray.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

Commanding Officer—Lieut.-Col. H. M. Leaf.

The following orders have been issued:—

Friday, May 8th.—"D" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.
Saturday, May 9th.—Headquarters will be open for regimental purposes only from 10 a.m. to 12 noon.
Monday, May 11th.—"A" Company. Supper at St. James' Tavern, St. James' Park Station, at 7 p.m.
Tuesday, May 12th.—"B" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.
Wednesday, May 13th.—Rating examination, all companies.
Thursday, May 14th.—"C" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.
Friday, May 15th.—"D" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.
Saturday, May 16th.—Musketry practice at Purfleet Rifle Range, at 1 p.m. to dusk.

(Signed) F. R. Holt-White, Capt. R.E., Adjutant,
For Officer commanding L.E.E.

A Gyroscopic Motor-Car.—Dr. Pierre Schilowsky has applied the gyroscopic principle to a petrol-driven motor-car, which runs on two wheels, and has been exhibited in London this week. A gyroscope weighing 7 cwt. is used to stabilise the car.

EXPORTS STATISTICS OF SWITZERLAND.

The following figures showing the exports of electrical and similar machinery from Switzerland in 1912 are taken from the recently issued official trade statistics; the particulars for 1911 are added for purposes of comparison and notes of any increases or decreases are given :—

Dynamo-electric machines and electric transformers of all kinds.—

	1911. Francs.	1912. Francs.	Inc. or Dec. Francs.
To Germany	2,742,000	2,837,000	+ 95,000
,, Austria	767,000	1,093,000	+ 326,000
,, France	4,675,000	3,756,000	— 919,000
,, Italy	1,298,000	901,000	— 397,000
,, Belgium	1,036,000	914,000	— 122,000
,, Great Britain ...	1,374,000	822,000	— 552,000
,, Russia	1,306,000	1,805,000	+ 499,000
,, Spain	1,319,000	1,410,000	+ 91,000
,, British India ...	253,000	280,000	+ 27,000
,, Mexico	156,000	24,000	— 132,000
,, Brazil	627,000	757,000	+ 130,000
,, Argentina	730,000	968,000	+ 238,000
,, Other countries ...	1,765,000	1,459,000	— 306,000
Total ...	18,048,000	17,026,000	—1,022,000

Hydraulic and wind motors.—

To Germany	1,342,000	1,223,000	— 119,000
,, France	999,000	848,000	— 151,000
,, Italy	549,000	500,000	— 49,000
,, Great Britain ...	352,000	480,000	+ 128,000
,, Russia	263,000	279,000	+ 16,000
,, Spain	385,000	468,000	+ 83,000
,, Japan	937,000	1,413,000	+ 476,000
,, Canada	566,000	81,000	— 485,000
,, Mexico	180,000	435,000	+ 255,000
,, Brazil	362,000	558,000	+ 196,000
,, Argentina	168,000	148,000	— 20,000
,, Other countries ...	1,060,000	1,566,000	+ 506,000
Total ...	7,163,000	7,999,000	+ 836,000

Steam engines, cranes, pumps, turbines, &c.—

To Germany	1,873,000	1,743,000	— 130,000
,, France	1,214,000	638,000	— 576,000
,, Belgium	1,280,000	1,249,000	— 31,000
,, Russia	1,428,000	1,549,000	+ 121,000
,, British India ...	441,000	203,000	— 238,000
,, Japan	183,000	269,000	+ 86,000
,, Canada	100,000	—	— 100,000
,, Other countries ...	1,164,000	2,589,000	+1,425,000
Total ...	7,683,000	8,240,000	+ 557,000

Gas, petrol, benzine, hot air, &c., motors.—

To France	1,884,000	2,406,000	+ 522,000
,, Italy	1,425,000	1,979,000	+ 554,000
,, Great Britain ...	1,151,000	770,000	— 381,000
,, Russia	1,132,000	862,000	— 270,000
,, Roumania ...	641,000	315,000	— 326,000
,, Egypt	432,000	1,039,000	+ 607,000
,, Algeria and Tunis	281,000	458,000	+ 177,000
,, Argentina ...	168,000	374,000	+ 206,000
,, Australia ...	279,000	301,000	+ 22,000
,, Other countries ...	1,878,000	3,918,000	+2,040,000
Total ...	9,271,000	12,422,000	+3,151,000

Electric meters.—

To Germany	106,000	291,000	+ 185,000
,, Austria-Hungary	134,000	150,000	+ 16,000
,, France	244,000	465,000	+ 221,000
,, Italy	207,000	198,000	— 9,000
,, Other countries ...	174,000	249,000	+ 75,000
Total ...	865,000	1,353,000	+ 488,000

Steam and electric locomotives.—

To France	1,093,000	797,000	— 296,000
,, Servia	109,000	—	— 109,000
,, Dutch E. Indies ...	493,000	157,000	— 336,000
,, Argentina ...	339,000	—	— 339,000
,, Other countries ...	83,000	504,000	+ 421,000
Total ...	2,117,000	1,458,000	— 659,000

Note.—25 francs = £1.

ELECTRICAL SMELTING OF IRON ORE IN SWEDEN.

[FROM OUR SPECIAL CORRESPONDENT.]

DIRECTOR E. J. LJUNGBERG, who formerly was the managing director of the Stora Kopparbergs Bergslags Aktiebolag in Sweden, and is still associated with this big concern as chairman of the board of directors, has recently expressed his views on the future of the electrical pig-iron industry in Sweden as far as this company is concerned, to a representative of the *Affärsvärlden*. The details given are of the greatest interest, as this company may be regarded as the pioneering company of the electrical smelting of iron ore, and the more so as they have been given by such an authority as Dr. Ljungberg, who, by the other ironmasters, has been honoured by the name of "the Grand Old Man." It will, however, first be necessary to give a brief description of the history of the electrical iron industry.

As may be known, the Swedish process of smelting iron ore direct by means of electricity was invented by the Swedish engineers Grönvall, Lindblad and Staalhane. After having demonstrated the process on a minor scale, the inventors transferred their patent rights to a company, which was formed under the name of the A/B Elektrometal, by which name the process is now generally known.

The Stora Kopparbergs A/B from the first took great interest in the invention, which finally resulted in the erection of an experimental plant at the Domnarfvets Ironworks, belonging to the company. An electrical furnace, with a capacity of about 700-800 H.P., was built at the above-mentioned works, where experiments were carried out during a period of about one year and a half with charcoal as fuel. These experiments gave such good results, that the Swedish Iron Office (Jernkontoret), which is a semi-financial and industrial institution for furthering the interests of the iron and steel industry, and the Ironmasters' Association, jointly granted the necessary capital (£14,000) for the erection of a large demonstrating plant with the view of ascertaining how the process would work on a larger scale. The chief purpose of these experiments was said to be the development of electric smelting of iron ore and placing it in such a position, that this method could be gradually introduced into the Swedish ironworks, after the private works and individuals had been given an opportunity of making the necessary tests with their own raw materials without being put to the expense and risks, which are connected with such experimental working separately. This excellent idea is only equalled by the practical manner in which the experiments have been carried out. The best engineers and the greatest experts that could be found were engaged, and nothing was neglected that could contribute to carrying the plan successfully through and to giving the results obtained the stamp of absolute trustworthiness. It was decided to erect the demonstration plant at the Trollhättan Waterfalls, where the necessary energy was available, and the work was started on November 29th, 1909. Scarcely one year after, viz., November 15th, 1910, everything was in full order, and the electrical furnace was put into operation. The furnace was designed for a consumption of 2,500 E.H.P., and estimated to be capable of producing 7,500 tons of pig-iron per year. Two transformers, each of 1,100 kilovolt-amperes, were installed for working the furnace. These are supplied with three-phase alternating current at 25 periods and a pressure of 10,000 volts, and they are coupled in Scott's connection. They yield a two-phase current with a voltage adjustable between 50 and 90 volts in eight stages, and in addition by change of connection on the secondary side, also from 100 to 180 volts.

The electrical energy is conveyed to the furnace chamber by means of four electrodes, each of which is made up by four single electrodes, with an aggregate section of 660 mm. square (26 × 26 in.) per electrode. The electrodes project through the arch of the furnace in a slanting position, forming an angle with the horizontal plane of 65°. The quadrangular electrode, when inserted in the arch, is surrounded by cooling jackets of copper, which are made tight by means of asbestos packing, in order to prevent any leakage of the furnace gases. A fan is installed for the circulation of the gas. With a gas temperature of 200° C. and a mixture of gas of equal volumes of CO and CO_2, the fan yields 70 cubic metres (2,470 cb. ft.) of gas per minute, against a 325 mm. water-pressure. This means a consumption of 8 H.P.

The furnance is encased in iron plates and measuring from the floor of the furnace to the upper edge of it, the height is 12·7 metres, and as the bottom of the furnace is 1 metre above the floor of the furnace house, it follows that the total height of the furnace from the ground is 13·7 metres.

The total volume of the furnace was 38 cubic metres, of which the melting chamber occupied 12·45 cubic metres. The total cost of the plant was £17,800, and the expenditure thus exceeded the original amount granted by about £3,800. The expenditure does not include anything for the production of the electrical energy but only for the transmission plant, as the energy was obtained from the Trollhättan power station by purchase.

Without going into details in regard to the working of the Trollhättan furnace, it is sufficient to say that the results have been very satisfactory, considering the various difficulties that have had to be overcome. One of these was, for instance, the varieties of charges employed. During the first five months the charges were continually changed, and there were no fewer than 29 charges used of varying composition, and it stands to reason that it must have been a very difficult task to make the furnace suit all kinds of ores, &c. The varying charges had naturally an unfavourable effect on the durability of the arch, but, on the whole, it must be said that the furnace stood the severe tests very well. The production of pig-iron in proportion to the consumption of energy varied considerably and was as low as 2·43 tons per H.P. per year, but it also reached 2·99 tons per H.P. per year. The results from high-grade ores were generally better than those obtained from low-grade ores. During the period November 16th, 1910-April 6th, 1911, the interruptions in the supply of electrical energy lasted 173 hours for phase 1 and 1,006 hours for phase 2, which was due to the fact that the transformer had to be repaired three times on account of defects.

In order to make the electrical smelting of iron ore pay, it has always been regarded as necessary by all experts to bring the production up to 3 tons of pig-iron per H.P. per year, and this result has since been achieved at the Trollhättan Works as well as at the Uddevalla Iron Works, where three furnaces of the Elektrometal type are now in operation. It must, however, be added that this furnace can only use charcoal as fuel and not coke, as the latter material has turned out to be unsuitable.

Passing now to the views expressed by Dr. Ljungberg, he says that it has now been established as a fact that the Elektrometal furnace is satisfactory in economic, as well as technical respects, and it has by this time been brought to such a degree of perfection that it is very doubtful whether the type can be improved upon, and any alterations with the view of increasing the production can scarcely come into consideration. But for the production of electrical pig-iron on a large scale, this furnace would not do, because the construction is not suitable for a higher consumption than 3,000 H.P., and in view of this the Stora Kopparbergs A/B has had to resort to another type, viz., the Helfenstein furnace, which is able to work with a load of 10,000 to 12,000 H.P. It has always been difficult to draw a comparison between the economic results from the production of pig-iron in the electrical furnace, and in the ordinary charcoal blast furnace, and up to the present it has, in fact, been quite impossible to obtain exact and reliable figures, because electrical smelting has not been carried on during a sufficiently long period to allow of such figures being given. The products have also mostly been employed at the producer's own works, which is one reason for the lack of figures that otherwise might have been available.

Electrical smelting, according to the Elektrometal process, has now arrived at a stage at which it is made to pay, and electrical pig-iron ought, as a rule, to fetch a somewhat higher price in the market than ordinary pig-iron.

As, however, the Elektrometal furnace is limited to a consumption of 3,000 H.P., the production will also be limited, and it is easy to understand that a furnace like the Helfenstein furnace, which is capable of consuming three or four times the amount of energy with a corresponding increase of the production, would have certain advantages, and ought to be a more suitable type of furnace for the production of pig-iron on a large scale, because the cost of manufacturing per ton for one large unit would, under equal conditions, be much lower than the corresponding figure for several small furnaces with less capacity.

Expenses, such as the ordinary working costs, depreciation, interests, repairs, &c., will, of course, be reduced in proportion to the production as soon as this is raised. These are the reasons why the Stora Kopparbergs A/B looked out for another type of furnace, and why the company has taken the risk of building a 12,000-H.P. Helfenstein furnace, although there was a Swedish furnace in existence that had passed the experimental stage. This furnace was completed at the beginning of last year, and experiments have since that time been carried out. They have not been altogether successful, and frequent disturbances of the work have occurred, so that the operations have repeatedly been discontinued in order to allow various alterations to be carried out.

There are still certain difficulties in the working that have not been overcome, but Dr. Ljungberg is very confident that the existing difficulties are not insurmountable, and that it is only a question of time and patience to get over the same. The company will unquestionably soon achieve the production of electrical pig-iron on a large scale.

The plans for the company's future activity during the first 10 years have already been prepared, and, according to these, it is the intention to increase the production of iron and steel gradually, so that the present annual production, which is somewhat under 100,000 tons, will be raised to about 300,000 tons per year. Out of this quantity it is the intention to produce about 200,000 tons of electrical pig-iron. This enormous increase will raise the total output of pig-iron of the whole country by about 25 per cent., and it is only natural that this activity will require a large quantity of electric energy. Provision has, however, been made for the necessary energy, which will be derived from the company's own waterfalls by a further harnessing and regulation of the same. The total amount of power required for this industry alone will be about 70,000 electrical H.P.

With reference to the raw materials needed, the company is just as self-supporting and independent as it is in the question of energy, and there is no necessity to go to the market, as the additional quantity of 500,000 tons of ore per year will be obtained from the company's own mines in Central Sweden, which are quite capable of yielding this quantity and even more for a good many years, when the mining operations are extended in accordance therewith.

It has always been a traditional policy of the company to avoid the export of raw materials, but to employ these instead for manufacturing purposes and then export the finished rolled products The same policy will also be pursued in future, and it is the inten-

tion, apart from the export business, to lay particular stress on the supplying of the Swedish engineering workshops with cheap raw materials, and also the building and railway industries.

It will, as mentioned before, require a period of about 10 years to put all these plans into operation. In the meantime there is every reason to congratulate the nation which is capable of producing such an enterprise, and also to congratulate the electrical industry upon the progress which is foreshadowed and partly realised in connection with the electrical smelting of iron ore.

NOTES.

American Electric Vehicles.—English Agencies.—Mr. E. W. Curtis, of the General Vehicle Co., New York, is visiting England with the view of establishing a number of agencies and branches for the sale of electric vehicles.

Electric Cooking.—On Monday last, at the invitation of Mr. R. F. Venner, we had the pleasure of putting his new electrical cooking apparatus to the test which proverbially is the only reliable and convincing proof of quality—not that we ate the apparatus; that would have been too tough a proposition. The occasion was an electrical luncheon at the offices of "Venner's Electrical Appliances," Walter House, Strand. The menu comprised grilled soles and salmon, grilled kidneys and sausages, roast lamb, baked potatoes, an omelette, and coffee—all prepared entirely with the Venner apparatus in the presence of the guests, who, however, were not in the least incommoded with fumes, odours and heat such as are associated with cooking by gas. The quality of the dishes was all that could be desired, and the simplicity of the processes through which they passed was remarkable—apparently all that needed to be done was to put the raw material in or on the cooker, and remove the finished article. Brains, however, are necessary to the attainment of perfection, and we must pay a tribute of respectful admiration to the skill of the accomplished artiste, Miss Campbell, in charge of the culinary arrangements.

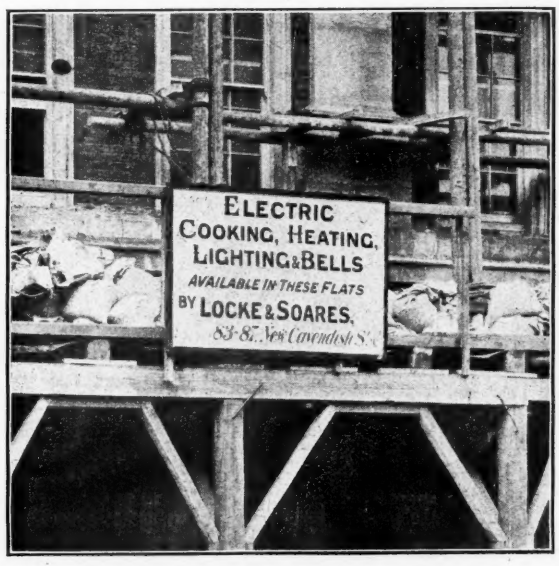
As regards the appliances with which such excellent results were obtained, we must defer a description of the details to our next issue; but, in the meantime, we may briefly indicate that the essential principle of the apparatus is the use of oil as the vehicle conveying the heat from the heating element to the metal surface upon which the food is cooked. Amongst other advantages, this plan ensures that the elements shall never be heated above about 450° F., and therefore are practically everlasting, while the efficiency of the transfer attains a very high value. In the case of the oven this principle is departed from, open elements being used, but there are various ingenious improvements in the design of the oven which will be found of interest.

Tangled Wires.—A correspondent in California writes:—Steel poles carrying high-voltage transmission wires were washed out by the high water along the Los Angeles River, at the Aliso Street Bridge. Three transmission lines and three trolley-wires were instantly entangled, and the ensuing fireworks were spectacular in the extreme. About 1,000 people had gathered at that

Collapse of a Transmission Line through Floods.

point to watch the storm water cutting into the river banks, and a swift scurrying to safety followed as sparks, flames and the smell of fusing metal gave the alarm. Fortunately, no one was injured by the tangling of wires carrying 15,000 volts, but the trouble man found all the trouble he was looking for directly afterwards. For hours the electric lines were out of commission, and light and power in various parts of the city were shut off.

A Sign of the Times.—The accompanying view is of considerable interest, as it indicates the trend of public opinion in the matter of domestic electrical uses. The board is fixed on a block of flats in Marylebone, and our energetic friend, Mr. Seabrook, also sends us another view showing much the same



All-Electrical Flats.

thing in the case of another block of flats. In Marylebone, at least, electric heating and cooking are becoming as well known as electric lighting; and if in Marylebone, why not in other London areas with similar requirements?

A Diesel Dinner.—An interesting function took place on Thursday last week at the Trocadero—namely, the first dinner of the Diesel Engine Users' Association, the youngest of the many organisations for special purposes which have sprung up in the engineering world. Mr. J. E. Edgcome, of Kingston-on-Thames, is the president, and occupied the chair at the dinner, which was attended by some 50 members and guests—mainly the latter.

After the loyal toasts, the success of the Association was proposed by the Mayor of Kingston-on-Thames, Councillor C. H. Burge, in an entertaining and discursive speech. Mr. Burge claimed for Kingston the distinction of being the first town in the kingdom which had installed Diesel engines of the horizontal type; he only regretted that they had to obtain them from Germany, which had reaped the advantage of being the birthplace of Dr. Diesel. The Association, he said, though in its infancy, was composed of veterans, and he hoped that it would grow and become more and more beneficial, not only to its own members, but also to the public in general.

Mr. Edgcome, responding to the toast, said he hoped the dinner would become an annual event. The Association was formed last year, its origin being a meeting of engineers using Diesel engines, who found that certain problems required attention, and desired to exchange experiences; the qualification for membership was "the use of Diesel engines," and the chief engineers of all large undertakings using them were eligible. The result had been satisfactory. The Diesel engine was invented no less than 21 years ago, and at present in England there were 450 engines at work, aggregating 86,000 H.P.; abroad there were 4,050, with 750,000 H.P. The members of the Association were few in number and exceedingly scattered, so that it was difficult to hold meetings that were fully representative, but when they did get together and related their experiences, the results were most important to themselves and to the whole industry of Diesel engines. Mr. Edgcome repudiated the idea that there was any antagonism whatever between the Association and the manufacturers; their interests were absolutely identical, and while the manufacturers fully and generously placed their knowledge at the service of the engineers, the experience of the latter was useful to the former. The users were constantly in touch with the engines and could point out features in which improvements could be made. The Association also could be of service in the matter of fuel oil. As long as the price of oil was kept at an abnormally high figure the general use of the engine would be retarded; 70s. to 80s. per ton delivered did not fairly represent the value of the oil. As the Association grew it would be able to exercise influence upon the people who were keeping up the price apparently for the sake of profit. Again, the Association would be useful in experimenting with different classes of fuel. At present it was practically impossible to obtain in this country a regular supply of gas tar oil, &c., of uniform quality and at a fair price. With the co-operation of the manufacturers the Association would exert a useful influence in this regard. He thanked the Association for electing him president for the first year.

Mr. W. E. Brandreth, hon. secretary, proposed the health of the guests, who were in the majority at that meeting, owing to the

scattered nature of their membership. He said they wished to work in perfect harmony with the manufacturers; frequent conferences would help them to eliminate troubles incidental to the Diesel as to other engines, and to render the plant more economical and reliable. It was only by running the engines that they could learn all about them, and their reports would help the manufacturers. Thus by attaining the objects for which the Association was founded, the demand for the engines would be increased and the costs of manufacture reduced—then the members of the Association would reap their just reward. The membership was not restricted to users of electrical generating plant, it was open to chief engineers of all concerns using Diesel engines. The representatives of many manufacturers were present; manufacturers were not at the moment eligible for membership, but were well represented on the Association, as the members all stuck up for the type of engine under their control.

In response, Mr. H. S. Russell (Messrs. Mirrlees, Bickerton and Day) heartily associated himself with what the president and secretary had said regarding the relations of the Association and the manufacturers. There had been a feeling at first that the Association was formed to get better terms from the manufacturers, but they were now in full agreement, and only too glad to profit by the experience of the users of Diesel engines. Mr. Russell concluded a humorous speech with apt quotations from "Macbeth," which, he contended, showed that Shakespeare knew a good deal about the Diesel engine.

Mr. G. Heath (Consolidated Diesel Engine Manufacturers, Ltd.) and Mr. J. M. Ferguson (Willans & Robinson, Ltd.) also replied, expressing their pleasure at being present, and agreeing that the assurances given the manufacturers regarding the intentions of the Association had been fully realised.

Finally, Mr. G. Porter proposed the health of the President, who, he said, was chosen because he was the best man for the post, and Mr. Edgcome briefly replied.

A programme of music was interspersed with the speeches, and the entertainment, as a whole, was highly successful.

Institution and Lecture Notes. — INSTITUTION OF ELECTRICAL ENGINEERS.—For the annual election of ordinary members of Council, in addition to the eight names put forward by the Council for the six vacancies (which we published in our issue of April 30th), several other nominations have been made from outside the Council:—

MR. REGINALD WALLIS-JONES, consulting electrical engineer, has been nominated by 60 members, including Sir David Salomons, Capt. H. R. Sankey, Messrs. A. L. C. Fell, Justus Eck, A. T. Snell, F. H. Nalder, A. Gay, E. Garcke, E. Manville, Col. H. M. Leaf, &c.

MR. FRANK AYTON, electrical engineer to Ipswich Corporation, has been nominated by 10 members, namely, Messrs. A. C. Cramb, A. Hugh Seabrook, R. A. Chattock, H. Faraday Proctor, Thos. Roles, John Christie, S. L. Pearce, W. Wyld, J. E. Edgcome and C. S. Davidson.

MR. JOHN CHRISTIE, electrical engineer to the Brighton Corporation, has been nominated by Messrs. W. W. Lackie, Frank Ayton, C. Furness, A. S. Blackman, J. W. Beauchamp, S. J. Watson, E. E. Headley, F. M. Long, W. A. Vignoles and H. Richardson.

It is interesting, especially to members of the Incorporated Municipal Electrical Association, to note that Messrs. Ayton and Christie's supporters are drawn entirely from the ranks of the I.M.E.A., and that they include almost the whole of the engineer members of the Council of that Association. So remarkable a circumstance can hardly be of accidental origin, and, no doubt, it will have its effect upon the voting, the result of which will be interesting, as there are now 11 nominations for 6 vacancies.

DUBLIN SECTION.—A very enjoyable function took place in the Lecture Theatre, Leinster House, Dublin, on Saturday last, when the Local Section of the Institution held their annual conversazione. The Theatre, which had been kindly placed at the disposal of the Committee by the Royal Dublin Society, presented a very festive and brilliant appearance. The guests, numbering about 200, were received by the chairman, Mr. G. Marshall Harris. The gathering included representatives of the various scientific and engineering associations in the city. Amongst those present were Capt. Adcock, Mr. J. C. Cowan, Mr. W. H. Tasker, Major Harriss, Mr. G. Idle, Capt. C. Jones, Col. Macartney, Prof. Orr, Mr. A. G. Porte, Dr. Probst, Mr. Robinson, Mr. Mark Ruddle, Prof. Scott, Mr. Tomlinson (hon. sec.), and Capt. Webber. During the evening a programme of vocal and instrumental music was carried through, amongst those contributing being Miss Stanford Campbell and Messrs. W. Lewin, J. E. Payne, G. White, Wesley Guard, J. R. Morgan, and H. Baynton ('cellist), while Mrs. White acted as accompanist. Mr. Frank L. Baynton's string orchestra played a charming selection of music during the reception and the interval. The musical programme was varied by two brief but interesting lectures by Prof. G. A. J. Cole, F.G.S., and Dr. Pollock. The former dealt with scenes in some of the walled towns of Southern France and Germany; while Dr. Pollock chose as his subject a description of notable scenes in Cyprus. Both lectures were well illustrated by lantern slides, and were much appreciated by the audience.

On Tuesday last the paper on "Current Limiting Reactances on large Power Systems," by Messrs. K. M. Faye-Hansen and J. S. Peck, was submitted to the members of the SCOTTISH LOCAL SECTION at Glasgow. A discussion followed.

At the meeting of the BIRMINGHAM LOCAL SECTION, on Wednesday last, a paper was read by Mr. A. M. Taylor, at Summer Lane generating station, on "Static Transformers for the Simultaneous Changing of Frequency and Pressure of Alternating Currents," and was followed by a discussion.

ROYAL SOCIETY OF ARTS.—On Tuesday, Mr. Charles Bright, F.R.S.E., read a paper on "The Administration of Imperial Telegraphs," in which he advocated the laying of a State-owned Atlantic cable and a cheap tariff for messages within the Empire, as well as a permanent central authority to control the inter-Imperial telegraphs, including the Pacific cable and the wireless chain.

ELECTRICAL CONTRACTORS' ASSOCIATION.—On Wednesday last the annual dinner of the Association was held at the Grand Hotel, Leicester; Mr. H. S. Webb, the president, occupied the chair, and some 50 members and guests were present. A report will appear in our next issue.

VEREIN DEUTSCHER ELEKTROTECHNIKER.—The annual meeting is to be held in Magdeburg, from May 24th to the 28th. Papers are to be read by Dr. F. Foerster on "Electro-Chemistry," by Dr. Ing. Guggenheim on "Electric Steel," by Prof. Dr. Dieselhorst on "Progress in Wireless Telegraphy," by Prof. Josse on "Condensing Plants," and by Herr O. Krell on "Electricity on Ship-board." A number of visits are also to be paid during the gathering, including one to the municipal central electric lighting station in the town, one to the works of Messrs. Schaffer and Budenburg, and another to the engineering establishment of Messrs. R. Wolf.

Concert.—The annual smoking concert of the electrical engineers' department of the Great Eastern Railway, held at the Cannon Street Hotel last Saturday, was a great success. The company present numbered over 600, and included Sir Ailwyn Fellowes, K.C.V.O., deputy chairman of the G.E.R., and the following officers:—Mr. Wm. C. May, chief goods manager; Mr. A. J. Hill, locomotive superintendent; Mr. S. A. Parnwell, land agent; Mr. A. E. Dolden, accountant; Commander Coysh, Marine superintendent; Mr. G. Keary, district superintendent; Mr. J. H. Wardley, engineers' department; Mr. A. O. Shave, printing works; Mr. A. P. Parker, general manager's office; Mr. E. S. Tiddeman, loco. department; Mr. G. Bird, engineers' department; Mr. W. Greenfield and Mr. C. T. Wells, superintendent's department; and Mr. Dodson, goods manager's office.

The visitors included Mr. W. Duddell, President of the Institution of Electrical Engineers; Mr. Roger T. Smith, electrical engineer, Great Western Railway; Mr. T. Stevens, consulting electrical engineer; Mr. P. V. McMahon, engineer, City and South London Railway; and Mr. Harcourt Williams, of the British Thomson-Houston Co.

Mr. Duddell proposed the toast, "The G.E.R., its Chairman, Director and Officers," and Sir Ailwyn Fellowes responded; Mr. D. James proposed "The Visitors," and Mr. Roger T. Smith replied; Mr. W. C. May proposed "The Chairman of Concert" (Mr. Frith), and Mr. Frith suitably responded. "The Committee and Hon. Secretary" was proposed by Mr. H. W. Frith, Mr. J. W. Ball, hon. secretary, replying.

The Building Trade Dispute.—The men have ballotted as follows respecting the modified disability clause and other proposals:—In favour, 2,021; against, 23,481. Majority against, 21,460.

Appointments Vacant.—The Kent Education Committee is inviting applicants for the post of head of the Engineering (Mechanical and Electrical) Department at the Technical Institute now erecting at Ashford (£150 to £180); borough electrical engineer (£450) for Greenock; draughtsman (temporary) for Newport electricity department; posts and telegraphs inspector for Gold Coast Government (£250), age 25 to 40. Particulars are given in our advertisement pages.

The Engineers of the "Titanic."—Last week a monument, erected in Southampton to the memory of the engineers of the *Titanic*, who died at the post of duty, striving to keep the vessel afloat, was unveiled by Sir Archibald Denny, and formally dedicated.

Inquiry.—A correspondent wants a simple and cheap controller for an electric launch.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—At last week's meeting of the Greenock Town Council, reference was made to the resignation of MR. J. A. ROBERTSON, the borough electrical engineer, who was going to Salford. Treasurer Williamson said that he could not speak too highly of Mr. Robertson's ability and admirable service. During his 11 years at Greenock the department had progressed with great rapidity. The Electricity Committee had appointed him consulting engineer until the completion of the extension to Port Glasgow. They also intended to ask him to guide them in appointing his successor. At the closing meeting of the Scottish Local Section of the I.E.E., of which Mr. Robertson is president, he was congratulated upon his new appointment, and received a vote of thanks for his management of the Section for the past 12 months.

MR. NORMAN STANILAND, the borough electrical engineer of Hornsey, is to have his salary increased from £500 to £550 per annum.

Mr. Charles Lill, sales engineer of the electricity department of the Hackney B.C., has resigned on securing an appointment with Messrs. J. & H. Grevener as engineer in charge of their motor and dynamo department. Mr. C. J. Smith, mains prime cost clerk at Hackney, has secured an appointment under the Shanghai Municipal Council. Mr. F. G. Taylor, at present sales prime cost clerk, takes the place vacated by Mr. Smith, and Mr. G. W. Dawkins, at present works general clerk, takes Mr. Taylor's former position.

Mr. Sydney Trow Smith, of Leek, has been appointed, out of 33 applicants, gas and electrical engineer to the Malvern U.D.C., at a salary of £350, rising to £400, *vice* Mr. W. H. Johns, who is proceeding to West Bromwich.

The Darwen Electricity Committee has recommended that the salary of Mr. C. Garnett, the electrical engineer, be increased by £50 a year.

Mr. H. P. Stokes, electrical engineer and tramways manager to the Bexley Urban District Council, has had his salary increased by £100 per annum.

Tramway Officials.—A serious accident happened on Friday last to Mr. Waldeman Jensen, manager of the Chatham and District Light Railway Co. He was about to enter a car at Gillingham when he was knocked down by another car, and fell between the two. He was badly crushed and sustained a serious cut on the head, necessitating his removal to the Hospital.

General.—According to the *New York Times*, Mr. Newcomb Carlton has been elected president of the Western Union Co. in the place of Mr. Vail, this step having been rendered necessary owing to the arrangement between the Attorney-General and the American Telephone and Telegraph Co. for the severance of relations with the Western Union. Messrs. C. W. E. Atkins and Belvidere Brooks have been elected vice-presidents, Mr. W. H. Baker secretary, Mr. A. R. Brewer treasurer, Mr. E. T. Gallaher controller. The executive committee is composed of Messrs. Baker, H. A. Bishop, Carlton, H. C. Davison, T. E. Hubbard. R. S. Lovett and M. L. Schiff. Mr. Carlton has returned to the United States.

Mr. E. J. Nally, vice-president and general manager of the American Marconi Co., is at present in London.

Mr. Geo. Ward, of the Commercial Cable Co., is expected in London in June next.

As a memento of Her Royal Highness's visit to the district, the inhabitants of Rhondda last Friday presented to Princess Alexander of Teck a "Ceag" electric miner's lamp in solid silver. It was an exact copy of the standard collier's "Ceag" lamp which, as our readers will remember, took the first prize in the competition of a year or two ago. The presentation lamp was supplied by the "Ceag" Electric Safety Lamp Co., Ltd., through Messrs. Haslam & Schontheil, Ltd., of Cardiff.

According to the *Financial Times* the twelfth annual dinner of the Eastern Telegraph Schools' Athletic Club was held last Friday evening, at the Holborn Restaurant. The chairman, Mr. F. A. Johnston, in proposing "The Club," referred to the retirement, after 41 years' service with the company, of Mr. T. A. Bullock. Mr. P. Burrell, president of the School, replied. A gold cigarette case, subscribed for by those present, was handed to Mr. Bullock, who, in responding, referred to the great changes that had taken place during his service with the company. Other speakers included Mr. J. C. Denison-Pender, M.P., and Mr. W. Slingo.

Mr. Roderick MacLeay, senior supervisor at the Portsmouth Dockyard electrical power station, is entering upon a commercial career at Montreal, Canada.

The marriage took place at Uley Parish Church last week of Mr. S. V. Lancey, electrical engineer, of Southampton, and formerly of the electrical staff of Mawdsleys, Ltd., of Gloucester, and Miss Rose Lusty, daughter of Mr. Lewis Lusty, of Uley.

The marriage took place at St. Paul's Church, Herne Hill, London, on April 18th, of Mr. Thomas Mountford Taylor, elder son of Mr. Thomas Taylor, J.P., of the firm of Taylor, Tunnicliffe and Co., electrical china manufacturers, Eastwood, Hanley and Longton, and Miss Dora Hair Masters, third daughter of Mr. J. John Masters, of Brent Lodge, Norwood Road, Herne Hill. They were the recipients of many valuable presents.

Obituary. — Robert Kaye Gray.—With profound feelings of regret we have to record that Mr. Robert Kaye Gray breathed his last on Tuesday afternoon at Brighton, after a long illness, in his 63rd year. In our issue of November 25th, 1904, we reproduced the most lifelike photograph obtainable of Mr. Gray, together with a brief account of his career and exceptional qualities. He was a prince among Presidents of the I.E.E., and had thousands of admirers and friends in telegraph and electrical circles in all parts of the globe who will learn with pain of his death. We shall make more extended reference to the matter next week, but for the information of those desiring to attend the funeral, we would say that the ceremony is to take place on Saturday afternoon. The remains will leave Lessness Park, Mr. Gray's residence at Abbey Wood, at 3.45 p.m., and the interment will take place at St. Michael's Church, East Wickham, at 4 o'clock. A convenient train leaves Charing Cross Station at 2.12 o'clock, and Cannon Street at 2.20 o'clock, for Abbey Wood Station. Friends will proceed direct from the station to the Church.

The death occurred on March 15th of Mr. John Kneeshaw, tramway traffic superintendent, at Sydney, under the New South Wales Railways Commissioners. He was in his 53rd year.

Mr. A. N. Banister.—The death is announced of Mr. Alan Neville Banister, formerly for some years manager of the Norwich Electric Tramways Co. He was 54 years of age, and passed away on April 22nd at the Homestead, Galleywood, Essex.

NEW COMPANIES REGISTERED.

Setok Syndicate, Ltd. (135,394).—This company was registered on April 23rd, with a capital of £1,500 in 1,000 ordinary shares of £1 each and 10,000 deferred shares of 1s. each, to acquire and deal in land, mines, forests, minerals, railways, buildings, business concerns, stocks, shares, patents and property of all kinds, to carry on the business of an electric light company, to construct railways and other works, &c. The subscribers (with one share each) are:—B. B. Kingsford, Whiteholm, Laurel Road, Barnes, S.W.; Major M. O. Donel, 46, Bassett Road, Notting Hill, W. Private company. Table "A" mainly applies. Secretary (*pro tem*), C. F. Mitchell. Registered office, Central House, Kingsway, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Pernambuco Tramways and Power Co., Ltd.—Issue on April 7th, 1914, of £100,000 debs., part of a series of which particulars have already been filed.

Sheerness and District Electric and Traction Co., Ltd.—Issue on March 27th, 1914, of £1,750 debs., part of a series of which particulars have already been filed.

Lamp Manufacturing Co., Ltd. (76,151).—Capital, £10,000 in £1 shares. Return dated February 3rd, 1914. 5,400 shares taken up. £5,400 paid. Mortgages and charges: £2,500 debs.

Hove Electric Lighting Co., Ltd. (36,942).—Capital, £100,000 in 15,000 ord. and 5,000 pref. shares of £5 each. Return dated March 24th, 1914; all shares taken up; £100,000 paid. Mortgages and charges: £44,600.

I. Frankenburg & Sons, Ltd.—Capital, £250,000 in £10 shares (12,500 pref.). Return dated February 23rd, 1914: 12,465 ord. and 10,120 pref. shares taken up; £10 per share called up on 2,965 ord. and 120 pref.; £30,850 paid; £195,000 considered as paid on 9,500 ord. and 10,000 pref. Mortgages and charges: Nil. (A further 105 pref. shares were allotted for cash on March 31st.)

CITY NOTES.

Evered & Co., Ltd.

The directors report that the accounts for 1913 show, after providing for debenture interest, £1,410, and income tax £418, a net profit of £1,637, making, with £4,309 brought forward and £4,000 which it is proposed to transfer from the reserve, £9,946 to be dealt with. They recommend a dividend of 4 per cent. free of income tax, absorbing £6,830, that £1,000 be written off plant, and that £2,116 be carried forward. The directors record the death of Mr. Richard George Evered, the managing director of Surrey Works, which took place in January, and which is a great loss to the company, as he was a man of great business ability, keen insight, and indefatigable perseverance.

The result for the year is disappointing. This is due partly to a falling-off in the Mediterranean export branch of trade that showed itself in the first half of the year, and partly to the dislocation of business resulting from the rearrangement of the system of distribution of goods, started in June, involving the reduction of the Drury Lane establishment, and the transfer to the works of nearly the whole of the London trade and stock. The directors are satisfied that their policy is the right one, and that it will justify itself in subsequent years by a saving of expenses more than equivalent to the trade lost; but, while the latter effect has been immediate, the reduction of the London establishment must take some twelve months to carry completely into effect. Of the Drury Lane premises rendered vacant by the change, the larger portion has already been satisfactorily disposed of, and there can be no doubt that the remaining part will very shortly be let. Another result of the transference will be that the one single stock kept in Birmingham, while more complete and of greater amount than either of the two stocks kept hitherto, will be of less value than the two combined. In addition, therefore, to the reduction in expenses, there will be an appreciable amount of capital released by this reduction in stock. Much of this capital was provided in the past by profits placed to reserve, employed in the business. In all the circumstances, therefore, they feel justified in recommending the appropriation of a comparatively small sum from the reserve, as this stands at a large amount and is an accumulation of undivided profit.

Mr. E. T. Read has been appointed to the general managership of the works. Mr. R. G. E. Freeman and Mr. Harold Evered have been elected to seats on the board.

Melbourne Electric Supply Co., Ltd.—The directors announce that, in view of the fact that the company's earnings foreshadow the maintenance of the dividend of 10 per cent. paid on the consolidated ordinary stock last year, they have decided to equalise the interim and final dividends, and have accordingly declared an interim dividend at the rate of 10 per cent. per annum, free of income-tax, payable on June 2nd in respect of the half-year to February 28th.

Auckland Electric Tramways Co., Ltd.—The directors have declared a dividend of 7d. per share for the half-year to December 31st.

Adelaide Electric Supply Co., Ltd.—The directors have declared an interim dividend of 5s. per share on the ordinary shares.

Kaministiquia Power Co.—A quarterly dividend of 1½ per cent. is announced, as compared with 1¼ per cent. a year ago.

West African Telegraph Co., Ltd.—A final dividend of 4s. per share is announced, making 4 per cent. for the year.

Anglo-Argentine Tramway Co.

MR. J. B. CONCANNON presided at Winchester House, E.C., on Monday, over the annual meeting of the above company.

In moving the adoption of the report (see ELECTRICAL REVIEW, page 709), the CHAIRMAN referred first to the death of three members of the board. Continuing, he said, no doubt they were all aware that business in the Argentine during 1913 showed no improvement upon 1912, which was not a good year, but rather the contrary, and naturally the commerce of the City of Buenos Ayres suffered in consequence. It was all the more pleasant therefore to be able to congratulate them upon the continued progress made by the company. The total number of miles run, namely, 50,872,935, showed an increase of 6·51 per cent. over 1912, while the number of passengers carried, 342,140,422, increased by 25,880,325, or 8·18 per cent., and the total receipts were better by £208,382, or 7·56 per cent. The expenses showed an increase of £145,140, mainly under the head of wages consequent upon the additional mileage. Thanks to lower freight rates for coal and to continued economy in the consumption of current, there was an actual decrease in the costs of £5,348, as compared with 1912, although the cars ran 3,107,268 more miles. The expenditure included £347,650 spent upon overhead lines, cables, permanent way, rolling stock, and buildings, as well as £150,000 credited to the renewals fund. The latter fund was charged with £147,652 for renewals effected during the year. The net revenue account, including the balance £9,253 carried in from 1912, after providing the city company's annuity, interest on debenture stocks, interest on temporary loans, dividends on both classes of preference shares, provision for sinking funds on the 4 per cent. and the 4½ per cent. debenture stocks and the share capital, left a balance available for dividend on the ordinary shares of £232,795, an increase as compared with 1912 of £23,490. The interim dividend paid on the ordinary shares absorbed £100,000, and they now recommended a final dividend which would require £119,375, leaving a balance of £13,420 to be carried forward to the 1914 accounts. The subway construction work was making rapid progress, and they hoped by August next to complete the extension of the first section. The subway lines in operation were giving satisfactory results. The owners of the ordinary share capital had taken up 150,000 new shares at £5 5s. net to the company, and the balance of the 5 per cent. debenture stock, £1,500,000, was issued in February last, the applications for which amounted to £2,482,600. Upon the question of possible motor-omnibus competition, to which he referred at the last annual meeting, they would be interested to hear that the municipal Council had recently declined to grant any concessions therefor, upon the grounds that the tramways system was sufficient for the public needs, and that the narrow streets and the paving system would make their operation inapplicable. For the current year up to March 31st the gross receipts showed an increase of £20,814 over those of 1913. As to the prospects for the remaining months, he referred them to the last paragraph of the general manager's report. [This paragraph reads:—"I do not, therefore, consider that we should by the end of the year show any falling off in receipts on the surface lines, and the receipts of the subway's working of the extension to Caballito will probably bring the total increases up to between 6 and 7 per cent. on the receipts of 1913."] His forecasts hitherto had been on the conservative side; let them hope that he had not been too sanguine this time.

MR. C. R. SANFORD seconded the motion.

Replying to Mr. A. F. Gurney, the CHAIRMAN said the reason for there being two sets of law charges in the accounts was because one set referred to London and the other to Buenos Ayres.

The report was adopted.

Mr. Leon Cassel, Mr. W. F. Hamilton, K.C., and Mr. G. A. Touche, M.P., were elected directors to fill the vacancies caused by death.

The CHAIRMAN proposed a hearty vote of thanks to the chairman and members of the local committee, Mr. Pedriali, the general manager, and the staff in Buenos Ayres and London.

The motion was carried.

The CHAIRMAN mentioned that there were now 26,000 debenture and shareholders connected with the company.

London Electrical Trading Co., Ltd.—The adjourned second ordinary general meeting of this company was held at 185, Wardour Street, London, W., on April 9th. In proposing the adoption of the annual report and balance-sheet for the 16 months ended at October 31st, 1913, the chairman, Dr. H. Charlton Bastian, F.R.S., stated that the turnover during that period had been more than doubled as compared with the preceding 16 months. In order to establish the position of the company in many markets, it had been necessary to accept low prices in the first instance, and, consequently, the net profits were small in proportion to the turnover. It was expected that the volume of business would be well maintained, and that better prices would be obtainable in future. The directors' recommendation that a dividend of 4 per cent. on the ordinary shares be declared, payable on July 1st, 1914, and that £255 be carried forward, was duly approved. Rear-Admiral Commendatore Persico, R.I.N., was re-elected a director.

Cork Electric Tramways and Lighting Co., Ltd.—The annual meeting was held at 83, Cannon Street, E.C., on Friday last, Mr. A. R. Monks (chairman) presiding. The proceedings were purely formal, and on the motion of the chairman, seconded by Mr. H. C. Levis, the report, as already published, was adopted.

Continental Notes.—NORWAY.—The annual general meeting of the G/S Norsk Elektrisk Metalindustri was held recently, and according to the directors' report, the results for the past year's working have been very satisfactory. The company was established four years ago with a capital of £41,670, and has carried on the electrical smelting and refining of zinc. The works are situated at the town of Sarpsborg, in the south-eastern part of the country.

It is reported from Trondhjem that the Meraker Co., which owns a number of pulp mills, carbide factories, &c., has lately bought some large deposits of limestone in the neighbourhood of Trondhjem, and is carrying on negotiations for the purchase of several others. The company has at the same time worked out the plans for the harnessing of several of the waterfalls belonging to it, and it is thought that the acquisition of the above-mentioned limestone deposits is closely connected with the latter scheme, and that the energy will be employed for the production of either calcium-carbide or nitrates, for both of which limestone is the raw material. The factories will be built at the port of Hommelvik, at the Trondkjemsfjord, where the company has secured large sites and to which place the transmission of energy offers no insurmountable difficulty.

SWEDEN.—A new company has recently been formed at Stockholm under the name of the Tungsten Wire Works, with a capital of £2,055, for the manufacture of tungsten wire.

AN ITALIAN AMALGAMATION.—A great financial transaction is impending in Naples, where the Società Meridionale di Elettricità is about to acquire the undertakings of the two other supply companies in Naples. These are the Società Napoletana, which has a combined share and loan capital of £420,000, and the Società Generale, whose united share and loan capital amounts to £1,000,000. At the same time, the debts of the Società Meridionale, which represent a total of nearly £600,000, and which have been chiefly contracted with the Société Financière Italo-Suisse, of Geneva, are to be converted into shares, and the share capital increased from £400,000 to £2,000,000. The other enterprises interested in the amalgamation are the Italian Meridional Railway Co. and the Banca Commerciale, and the completion of the scheme will combine all the electric lighting interests in Naples. It is next proposed to proceed with the erection of hydro-electric works in connection with the river Sangro, in the Abruzzi.

RUSSIA.—The United Cable Works Co., of St. Petersburg, report a net profit of £147,510 for the last financial year, as compared with only £102,160 in 1912. The dividend is being increased from 8 to 10 per cent.

GERMANY.—The report of the Bergmann Elektricitätswerke Gesellschaft, Berlin, for the last financial year shows that after making due allowance for depreciation, the net profit amounted to £158 930, as compared with only £119,000 in 1912. A dividend of 5 per cent. is again being declared, a sum of £10,500 is also being set aside for writing off doubtful debts, leaving £16,490 to be carried forward.

The report of the Gesellschaft Mix & Genest Telephon und Telegraphenwerke, of Schoneberg, Berlin, for the last financial year, shows a net profit of £14,650, as compared with a loss of £60,118 in 1912. A dividend of 4 per cent. is being declared.

BELGIUM.—La Société A.E.G. Union Electrique, of Brussels, the Belgian branch of the A.E.G. Co., reports a net profit of £11,890 for the last financial year.

La Société Belge d'Electricité, Eclairage, et Force Motrice, of Brussels, reports a profit of £940 for last year.

Japan.—The last Japanese mail brings the news that the Anglo-Japanese Water Power Electric Co., of Tokio, proposes to increase its capital from £120,000 to £300,000, with the object of establishing a new hydro-electric power station on the River Tomoe-gawa, at Aichi-ken. The company is at present running a power station of 3,000-H.P. capacity, and also taking current to the extent of 2,000 H P. from the plant of the Nagoya Water Power Electric Co. The demand for a supply of electrical energy in the Hamamatsu district has, however, so greatly increased that an extension of generating plant has become necessary.

A meeting of the shareholders of the Kyushu Electric Tramway Co. is about to be held at Kobe to consider a proposal to increase the capital of the concern to £630,000.

Western Union Telegraph Co.—The *New York Journal of Commerce*, of 15th inst., states that in view of the change in classification of accounts prescribed by the Interstate Commerce Commission, effective January 1st, 1914, the directors of the Western Union Telegraph Co. have decided that future quarterly statements submitted to stockholders at the time dividend cheques are forwarded, shall show the latest available results of actual operations, and that the practice of submitting partly estimated quarterly earnings shall hereafter be discontinued. The figures published for January and February are as follows:—Total operating revenues, $6,896,202 (decrease, $141,490); total operating expenses and taxes, $5,654,316 (decrease, $146,940); net income $1,241,886 (increase, $5,450).

Victoria Falls and Transvaal Power Co.—The *Times* states that the net earnings, including those of the Rand Mines Power Supply Co., for the quarter ended March 31st, amounted to £122,319.

Anglo-American Telegraph Co., Ltd.—Interim dividends for the quarter ending March 31st: 15s. per cent. on the ordinary stock and £1 10s. per cent. on the preferred stock, less income-tax.

German Electrical Companies.

The *Berlin Elevated and Underground Railway Co.* proposes to raise further capital for the purpose of meeting the monetary requirements in connection with the extensions in progress, and for extinguishing the debt to the bankers incurred on these lines. The sum to be issued is £1,000,000 in 5 per cent preference shares, and the transaction will be carried out by the Deutsche Bank and allied institutions.

The *Electricity Supply Co., of Berlin*, which is interested in a number of electricity works, has just made an issue of £500,000 in 5 per cent. obligations, which will be redeemed at par by annual drawings, commencing in 1920 and terminating in 1949. At present the company has an ordinary share capital of £1,500,000, and loans amounting to £954,000, these being all of the 4½ per cent. class.

The *Rhenish Schuckert Co.* has decided to increase its share capital by the issue of £150,000 in new shares, which have been taken over by a banking syndicate headed by the South German Discount Co. The shares are to be offered to present proprietors at the price of 123 per cent. in the proportion of one new to three existing shares. At the same time an emission of 5 per cent. bonds is to be made of the amount of £300,000, redeemable at 102 per cent. in 25 years.

The *A.E.G.* has resolved to realise a financial transaction indirectly through a subsidiary company. Although the recently formed A.E.G. Schnellbahn, which is to be constructed between Gesundbrunnen and Neukölln, has yet to be commenced, the parent company will shortly issue, through its financial syndicate, cumulative preference shares for £1,125,000, and £500,000 in ordinary shares of the new high-speed railway company. The dividend coupon on the preference shares will be guaranteed by the A.E.G. at the rate of 5 per cent. until the end of 1923, and from the beginning of 1924, when the new railway company will assume the entire responsibility, the rate will be reduced to 4½ per cent. The A.E.G. consequently assumes the difference of ½ per cent. on its own account for 10 years, or a total of 5 per cent. for the whole period, in order to secure a speedy realisation of the capital. The transaction is considered to be unusual in connection with an undertaking which is merely in an initial stage.

The *Sudsee Gesellschaft fur Drahtlose Telegraphie, of Berlin*, which was formed in 1912, for the purpose of establishing a wireless system in the South Seas, shows a loss of £740 through working expenses down to June 30th, 1913. The stations are valued at £63,000 on a paid-up share capital of £32,500, and loans of £18,000 and £16,500 have been granted by the German-Netherlands Telegraph Co., of Cologne, and the Berlin Wireless Telegraphy Co., respectively.

The *Kabelwerk Duisburg, of Duisburg*, after allotting £35,000 to depreciation in 1913, as compared with £24,000 in the preceding year, reports net profits of £48,000, as against £23,000 in 1912. It is proposed to pay a dividend of 16 per cent. on the capital of £150,000, as contrasted with 14 per cent. in 1912, and to place £24,000 to the reserve fund, this comparing with £5,700 in the previous year.

The *Treuhand Bank fur Elektrische Industrie, of Berlin*, which is a financial institution originally established by the Felten and Guilleaume Co., and now also associated with the A.E.G., reports net profits of £14,200 from interest receipts in 1913, as compared with £12,700 in 1912. It is intended to distribute 4 per cent. on the paid-up capital of £312,500 out of nominal capital of £1,250,000, this rate contrasting with 3½ per cent. in the previous year. The bank is shortly to be developed by the calling up of further capital and the acquisition of the shares held by the Felten & Guilleaume Co.

The *Norddeutsche Seekabelwerke, of Nordenham*, whose share capital of £300,000 is held in equal halves by the German-Atlantic Telegraph Co. and the Felten & Guilleaume Co., earned gross profits of £53,000 in 1913, as contrasted with £82,000 in the preceding year. After meeting general expenses and apportioning £24,000 to depreciation, as against £26,000 in 1912, the accounts exhibit net profits and balance forward amounting to £37,000, as compared with £51,000 in the preceding 12 months. It is proposed to pay a dividend of 5 per cent., as against 10 per cent. in 1912.

The *Elektrochemische Werke, of Berlin and Bitterfeld*, which belong to the group of the A.E.G. and the Zurich Bank for Electrical Enterprises, record gross profits of £84,000 for 1913 from manufacturing and dividends received, the company having a working community of interests with the Griesheim Elektron Chemical Works. The figures compare with profits of £82,000 in 1912. After defraying general expenses and setting aside £2,500 for depreciation of investments, the accounts indicate net profits of £61,000, as contrasted with £60,000 in the previous year. The directors recommend a dividend of 10 per cent. on the ordinary capital of £275,000, being the same rate as in 1912.

Eastern Extension, Australasia and China Telegraph Co., Ltd.—The directors have declared a dividend for the quarter ended December 31st of 2s. 6d. per share, together with a bonus of 4s. per share (or 2 per cent.), free of income-tax, making a total of 7 per cent. for the year 1913.

River Plate Electricity Co., Ltd.—For the year 1913 the net revenue was £42,201. A dividend of 10 per cent. on the ordinary stock is announced, carrying forward £13,062.

Rangoon Electric Tramway and Supply Co., Ltd.—The directors recommend a dividend of 6 per cent. on the ordinary shares, carrying forward £1,054.

Kalgoorlie Electric Power and Lighting Corporation, Ltd.

THE directors' report for the year ended December 31st, 1913, states that the result though less satisfactory than that of some previous years is, when considered in all its bearings, not unfavourable. During the year several small consumers who took power at a somewhat higher rate than the average have closed down and thus the power sales and profits show a decrease. Contracts have, however, now been entered into with new consumers which, there is good reason to believe, will restore the company's business to the previous level both in volume and profit. After providing for payment of the debenture interest and the full dividend on the preference shares, and placing £3,000 to the reserve for renewals and depreciation, there remains to the credit of profit and loss account £372 to carry forward. The small cash position shown has resulted from the heavy capital expenditure, amounting to £9,618, incurred during the past year in the installation of the 750-KW. Parsons turbo generating unit and other plant. With a view of building up the company's financial position, and to make provision for the debentures which fall due on December 31st, 1917, the directors have decided to reduce, for the present, the rate of dividend on the preference shares from 6 per cent. to 4 per cent. The dividend warrants will be posted to the shareholders on the 1st prox., together with a print of the report of the proceedings at the general meeting. The new unit, the Parsons turbine referred to above, is working satisfactorily, but as it was in operation for less than half of the year under review no important benefit was derived from it. The company has now sufficient machinery for all the business including a reliable stand-by equipment. The heavy expenditure for new plant, which during the last six years amounted to £62,120, may now be considered at an end. The plant, machinery and buildings have been maintained in first class condition; the whole of the machinery works with efficiency. The directors report the retirement from the board of Mr. R. W. Wallace, K.C., and place on record their appreciation of his services as chairman since the inception of the company. Mr. G. C. Howard, one of the largest shareholders in the company, has been elected a director. Mr. Edward Pope, who was for many years vice-chairman, has been appointed chairman.

The annual meeting was held on Wednesday.

Worcester Electric Traction Co., Ltd.—The directors report that the total revenue for the year 1913 amounted to £18,070, as compared with £15,771. After deducting all expenses chargeable to revenue, including a provision of £2,139 for renewals, there remains £4,258, plus the amount brought forward, making £4,539 available for distribution. The directors are placing to reserve £1,000; to dividend on the ordinary shares at the rate of 3½ per cent. for the year, £3,339; carrying forward £200. The net revenue for the year shows an increase of £1,633, due chiefly to the fine weather during the summer and to the operation of additional motor-omnibus services. The agreement with the Corporation of Worcester, under which the Corporation maintained the whole of the permanent way for £450 per annum, was determined on December 31st last.

Swansea Improvements and Tramways Co.—The directors report that the total revenue of the tramways undertaking for 1913 amounted to £69,683, an increase of £5,870. The traffic receipts were £67,169, an increase of £5,800. After deducting all expenses, debenture and other interest, and the amount payable to the Swansea Corporation in respect of the lines leased from the Corporation and setting aside £7,500 to the renewals fund, there remains a surplus of £14,832. The directors propose to place to reserve £4,000 and to pay a dividend on the ordinary shares at the rate of 6 per cent. for the year, carrying forward £2,185. Capital expenditure during the year amounted to £8,082. There was also expended during the year £4,023 on renewals of the permanent way, electrical equipment and plant, which is charged to renewals fund. During the year three short extensions of the lines were constructed by the Swansea Corporation.

Cuba Submarine Telegraph Co., Ltd.—The directors report that the total receipts of the 12 months ended December, 1913, were £38,491, while the expenses amounted to £15,473, leaving a balance of £23,017 plus £7,931 brought forward, giving a total of £30,949 to be dealt with. £3,500 has been placed to the pension fund, and £4,000 added to the general reserve fund, which now stands at £98,000. Interim dividends were paid on October 23rd, viz., at the rate of 10 per cent. per annum, less income tax, on the preference shares, and at the rate of 6 per cent. per annum, free of income-tax, on the ordinary shares. The above interim dividends absorbed £7,800, and leave £15 649, out of which the directors recommend the payment of final dividends at the same rates, making total dividends for the year of 10 per cent. on the preference shares, less income-tax, and 6 per cent. on the ordinary shares, free of income-tax, the balance, £7,849, being carried forward.

Tramways and Light Railways Estates Co., Ltd.—The total revenue for 1913 was £1,556. The available balance is £1,626, and it is to be appropriated as follows:—To reserve, £250; to reduction of goodwill, £100; to 5 per cent. dividend on the shares, £753; leaving to be carried forward £523.

Tramways and General Works Co., Ltd.—The *Financier* states that the directors have declared a dividend of 9d. per share of 6s. for the year

Grand Berlin Tramways Co.

THE report of the *Grosse Berliner Strassenbahn A.G.* for 1913 shows a decline in the growth in the receipts as compared with the preceding year, and the dividend which has just been declared is at the rate of 8 per cent. on ordinary share capital of £5,004,000, this contrasting with 8½ per cent. in 1912. The number of passengers carried increased from 463,000,000 in 1912 to 466,000,000 last year; the number of car-miles run also advanced, and the proportion of working expenses to receipts rose from 56·66 per cent. to 58·64 per cent. in the two years respectively. A further extension of 13·60 miles in the mileage took place, bringing the total length up to 367 miles at the end of 1913. At the recent general meeting it was stated on behalf of the directors that the undertaking was exposed to considerable competition in the second half of the year from municipal tramways, the Omnibus Co., and the Underground and Elevated Electric Railway Co. Both the latter had entered the best thoroughfares for traffic, and the effects of the opening of the railway company's extension *viâ* the Alexanderplatz to the Schönhauser Allee had been specially perceptible. Despite the keenness of the rivalry, which was scarcely likely to be repeated in the future, the tramway company carried 43,000,000 more passengers last year than all the other Berlin traffic undertakings combined, and the reduction in the second half was merely a ripple on the surface. It was only necessary to proceed with the regular development of the tramway system in order to equalise the decline, but this would not take place until the general economic conditions and general building activity had improved, the latter being particularly important to the company. Apart from these matters, the tramways were superior to the electric railways and the motor-'buses in material points. The railways were exceptionally expensive to build, and would remain limited to specially remunerative routes, whilst the motor-'buses had to reckon with substantially higher working expenses than the tramways, and required specially paved roads. On the other hand, the tramways possessed the advantage of cheap fares and season tickets and the lines were being extended right into the suburbs. The fall in the receipts had not been looked upon without taking action. In the first place the company had acquired omnibus shares to the extent of £200,000; secondly, it was hoped that the transport regulation against excess passengers, which exceptionally prejudiced the company as compared with the electric railway and the City Railway, would be abolished; and, in the third place, it was proposed to construct seven new ring lines and make extensions of existing lines to the extreme limits of the suburban boundaries. The construction of the lines was as good as assured. The company did not undertake unremunerative lines, as when a surplus was not expected the local authorities gave the assurance of large contributions. Discussions had taken place in regard to the acquisition of shares in the Underground and Elevated electric railway, but these had not led to any result. As to the suggested transport service for light goods, the opinion of forwarding agents was that it would be impossible for the company to even realise a profit of 8 per cent. on the business. As this was the percentage which had to be paid to the municipal council, the company would earn nothing if the branch were undertaken. In conclusion, it was mentioned that the new order in regard to the payment of fares by passengers had been urgently needed as the directors estimated the loss through evasion of payment by "bilkers" at £10,000 per annum.

Swiss Electrical Companies.

The *Société Franco-Suisse pour l'Industrie Electrique, of Geneva*, which is an investment company, reports gross profits of £110,000 for 1913, as against £104,000 in the preceding year. After making provision for the depreciation of securities and meeting interest charges on the loans of £931,000, the accounts show net profits of £63,000, as contrasted with £56,000 in 1912. It is intended to pay a dividend of 5½ per cent. on the share capital of £1,000,000, this rate comparing with 5 per cent. in the previous year.

The *Motor, A.G. fur Angewandte Elektrizitat, of Baden*, which has an ordinary paid-up capital of £1,200,000 and loans of £1,400,000, owns various supply works in addition to being financially interested in others, the latter department occupying the predominant position. The accounts for 1913 indicate net profits of £91,000, as compared with £66,000 in the previous year, and the directors recommend a dividend of 7 per cent., as in 1912. The report refers particularly to the formation of the Columbus Co., which was constituted in 1913 by Swiss, Italian and Argentine financial circles for the promotion of electrical enterprises in transmarine countries, especially in Argentina.

The report of the *Elektrizitats Gesellschaft Alioth, of Basle*, whose share capital of £240,000 is mostly held by the firm of Brown, Boveri & Co., of Baden, states that the company's workshops in Münchenstein had been disposed of to the latter company in return for paper securities. The total securities in portfolio now represented a book value of £300,000, and the company had consequently assumed essentially the character of an investment company, although the shares chiefly concerned manufacturing companies. The accounts indicate net profits of £13,000, as compared with £18,000 in 1912, but as no provision had to be made for depreciation of plant in 1913, it is possible to increase the dividend from 4½ per cent. in 1912 to 5 per cent. for last year.

The *Aluminium Industrie A.G., of Neuhausen*, states that the accounts for 1913, after placing £111,000 to depreciation as compared with £56,000 in 1912, show net profits of £266,000, as contrasted with £183,000 in the preceding year. It is proposed to pay a dividend of 20 per cent. on the paid-up share capital, being the same rate as in 1912, and to allocate out of the remaining balance the sum of £84,000 to the fund which was created for the purpose of gradually paying in full the uncalled capital on the ordinary shares, upon which 50 per cent. has hitherto been paid. Having made this appropriation the directors recommend that the amount of £104,000 should be transferred from this fund, which totals £109,000, for effecting a payment of 10 per cent. on the ordinary shares which will then be paid to the extent of 60 per cent. In addition it is intended to increase the share capital to £1,400,000 by the emission of further ordinary shares for £360,000, which will be offered to existing shareholders. The new capital is intended to serve the purpose in the first place of strengthening the financial position of the undertaking, and, secondly, to extend the existing plant as well as to develop the bauxite mines in the district of Bergheim, Cologne.

Berlin Elevated and Underground Railway.

THE report of the *Gesellschaft für Elektrische Hoch und Untergrund Bahnen, of Berlin*, states that the length of the company's own lines increased from 11 miles in 1912 to 16·9 miles last year. If to this mileage is added that appertaining to the Schoneberg, Wilmersdorf and Dahlem railways, which are worked by the company, the total length now reaches 23·3 miles. The average receipts per passenger, which amounted to 1·52d. in 1912, advanced to 1·54d. in 1913. The accounts show the following results for the two years:—

	1912.	1913.
Ordinary share capital	£2,500,000	£3,000,000
Gross profits	319,000	355,000
Interest on loans	81,000	97,000
Railway redemption fund	7,700	9,800
Renewal fund	36,000	44,000
City taxes	8,900	9,800
Depreciation	3,600	3,600
Net profits and balance forward	176,000	184,000
Dividend percentage	6	6

The dividend is payable on share capital amounting to £2,125,000. At the recent meeting the general director stated that the organic rounding-off of the system owned and worked by the company would be completed by the supplementary line from the Gleisdreieck (Triangle) to the Wittembergplatz, which was in course of construction, and by the Frankfurter Allee line, the beginning of which depended upon the widening of the Landsberger Strasse by the Municipal Council. At the request of certain local authorities, however, the company had prepared schemes for making extensions, and negotiations were proceeding with other authorities for further developments. In addition, the company had received sanction to establish two motor-'bus services, for which 60 'buses had been ordered, and the lines would be opened in the early future. The company had acquired a large interest in the Berlin Omnibus Co. The number of passengers carried by the railway advanced from 62,730,000 in 1912 to 71,530,000 last year, whilst the level line transported 2,450,000 persons in 1913, as compared with 2,240,000 in the preceding year. The former has an equipment of 226 motor coaches and 174 trailers, and the latter has 10 motor-cars and 7 trailers.

Sunderland District Electric Tramways, Ltd.—The report states (according to the *Financier*) that during the year to October 31st a scheme providing for the reduction of the capital was approved by the shareholders, and sanctioned by the Court on March 17th last. This scheme has been given effect to in the accounts now submitted, the amount provided by the reduction of capital being utilised in writing off various items of expenditure which had accrued and which were not represented by assets. After providing for interest on the prior lien bonds and the first mortgage debentures, sinking fund instalment and balance of receivership expenses, and transferring a sum of £1,000 to reserve account for law costs, &c., there remains a net profit of £2,717. Of this the directors have transferred £2,000 to reserve account, leaving £717 to be carried forward. In order to maintain an efficient service and to meet additional traffic, 16 new cars have been purchased and put into service, whilst various other improvements have been effected which should still further increase the net revenue. The traffic receipts for the past year show an increase of £4,608 over those for 1912.

Stratford-on-Avon Electricity Co., Ltd.—Mr. G. M. Bird presided at the annual meeting held on April 21st. He said that the sales had increased by £141, but the expenditure had advanced owing to an abnormal outlay on engines and producers of £182, as against £59 in 1912. They were recommending an increased dividend, but they were carrying forward a smaller sum. The business was steadily increasing, and for the last quarter of 1913 they sold 2,326 units more than in the corresponding quarter of 1912. The new plant would, they hoped, be sufficient for the next five or six years, but he did not wish them to expect that they were going to get an increased dividend every year. They had now reached 4 per cent., and they hoped to be able to maintain it. They ought to pay attention to reserves and to preliminary expenses. Later on they proposed to somewhat increase the capital by way of debentures. They were seeking power to raise £3,000, but they would not want more than £1,000 for a considerable time to come. The report was adopted.

Chloride Electrical Storage Co., Ltd.—According to a financial paper the directors recommend an ordinary share dividend for the year of 10 per cent., plus a bonus of 10 per cent.

La Plata Electric Tramways, Ltd.

The directors in their report for the year 1913 state that the average total length of single track constructed and in operation during the year was 27¼ miles. The total receipts on revenue account amounted to £62,324, and the expenditure to £45,252, leaving £17,072. After providing for debenture stock interest (£5,000) and charging £1,141, the amount payable in respect of arrears of municipal taxes in accordance with the decision of the Supreme Court of Appeal of the Province of Buenos Aires, and making further provision of £200 for bad and doubtful debts, there remains £10,732 which, with £598 brought forward, leaves a balance available of £11,330. An interim dividend of £4,000 was paid on the preference shares in October last, and the directors now recommend that there be put to reserve fund £1,000; a balance dividend on the preference shares absorbs £6,000, and there is to be carried forward £330.

Mr. W. F. Hamilton, K.C. (chairman), presided on Tuesday at Winchester House, E.C., over the annual meeting.

He said that the total receipts as compared with 1912 showed an increase of £9,145, and the expenditure an increase of £1,977, the net increase of profit being £7,168. The actual profit result had fallen short of their estimate by nearly £3,000. Unfortunately during the latter part of the year acute financial depression had prevailed in Argentina and the country generally, and La Plata in particular was experiencing a very anxious time. Last year they had every reason to expect that the proposed new shipbuilding and repairing yard would be begun at Ensenada, but no doubt owing to the state of the money market, they had been disappointed. Their prosperity depended upon that of the country, and therefore it would have been surprising if their anticipations had been realised. Their manager had done his utmost to keep down expenses, but in bad times traffics necessarily decreased. He might mention that their working expenses per car-mile run were only 6.67d., which was lower than those of any other tramway system with which he was acquainted. The current year did not up to the present shew any improvement in the financial position, but all who knew Argentina were convinced that the set-back was only temporary, the result of over-speculation in land, bad harvests, and drought, combined with a world-wide stringency of money. The chairman went on to refer to the company's share of Municipal and Government paving carried out to date. Considerable paving had been carried out, and the company's share to date might amount to some £10,000, which they would liquidate under the Paving Law of December 1909 by an annual payment of 6 per cent. for interest and amortization until the whole of the principal sum was amortized. They had registered at Somerset House the Supplementary Trust Deed for the balance (£100,000) of the authorised amount of debenture stock. They had under consideration the issue of some of this stock to provide for their requirements and pay off their existing loan. During the whole of the year they had had the Ensenada line in full electrical operation, whereas in 1912 that line only started operation on 23rd September, so that the increase in general traffic expenses and power was explained by the extra car mileage run on that line. Under Mr. Valentine Brown's able management, the cost of current in 1913 worked out, notwithstanding the increased cost of coal at 2.02d. per car mile run, as compared with 2.19d. in 1912, and he had succeeded in training the men to reduce the consumption of current by judicious handling and running of the cars. In the net revenue account there was a charge amounting to £1,141 for arrears of Municipal taxes. Their concession provided for an entire exemption from taxation whether Provincial or Municipal for a period of ten years, and when accounts were presented for taxes for street lighting, cleaning, water supply and drainage, they felt it incumbent on them to resist them. The Supreme Court of Appeal of the Province of Buenos Aires had, however, decided that these taxes were not taxes within the meaning of the exemption under their concession, but constituted payment for services which they, in common with everyone else, enjoyed. The Central Argentine Railway, the Buenos Aires Western Railway, and the Great Southern Railway had also fought these cases like themselves and lost them. They considered it would be waste of time and money to continue fighting them, and consequently they had paid up the arrears and fines amounting to this total of £1,141. With reference to their action against the late auditors, progress had been delayed by the necessity for bringing over to this side the books of accounts and other documents used in La Plata, and by the preparation of the detailed particulars required by the court. Although the present immediate prospects were not so bright as they wished them to be, he was still confident of the future of the company. Owing to the congestion of sea-borne traffic in Buenos Aires, the overflow must find its way to La Plata, whilst the available space for factories of all kinds was practically unlimited. The increase of population that this must bring would not fail to benefit the company, and all they had to do was to keep expenses at a minimum during this temporary depression. No man was more alive to this necessity than their present manager, whom they hoped to see during the coming summer.

Mr. W. T. Western seconded the motion, and the report was carried without discussion.

Johnson & Phillips, Ltd.

Mr. Robert W. Blackwell presided over the ninth annual general meeting, held at Winchester House, E.C., on April 23rd.

In moving the adoption of the report, the Chairman said the accounts showed a further distinct improvement. The trading profit, after providing £7,341 for maintenance of plant, amounted to £33,175, which was £4,851 better than last year. Adding the balance brought forward they had a total of £36,491 to deal with. From that sum, they must deduct directors', auditors' and trustees' fees £1,835, debenture interest £8,940, debenture amortization £6,477, depreciation on machinery and plant £8,155, and interest on bank loan £309. There remained a balance, which it was proposed to carry forward, of £12,755. Their property was steadily improving in value and the business increasing on safe and conservative lines. Their turnover had largely increased. They had dropped all work which was not really productive and each department of the business showed a profit on the year's working. Their trading position was distinctly satisfactory. On the 31st December last, sundry creditors and bills stood at £94,311, against which there was owing to them £107,855. They had a stock of goods and work in progress amounting to £159,546, investments of £2,405, and cash in hand £14,310. Their valuations had been carefully and conservatively made and the stock was taken at less than market value. During the past year they spent, in addition to the manufacturing plant, £20,121, which disbursement was essential to the well-being of the business. He had repeatedly called their attention to the necessity of improving the plant and bringing it up to date. In eight years they had increased the property account by £63,000 and written off to depreciation £37,000. That meant £100,000 spent on improving the earning power of the concern. The original issue of first mortgage debentures had now been decreased by £49,541, and as they already knew, the floating debt of the company was last year converted into a 5 per cent. 20-year debenture for £50,000. He appreciated that there might be a natural disappointment that the Board had not proposed a dividend. That they were not prepared to do, but they believed that on the next occasion they met a dividend would be declared, and that, thereafter, the shareholders might expect a reasonable return upon their investment with regularity and certainty. In general, he might say that the business of their company was being well maintained. They had an ample supply of work at fair prices which should keep their shops employed for a great part of the present year.

Mr. Thomas Deuce seconded the resolution.

Mr. W. H. Morgan (shareholder) said that several companies carrying on work and business similar to that which they were doing had during the past year been very prosperous. He hoped the trading of the company in the near future would be more satisfactory to ordinary shareholders.

The Chairman said that the working capital had unquestionably been insufficient, but he thought that taking everything into consideration, those deficiencies had now been put right.

The resolution was carried, and the retiring directors were re-elected.

Chesham Electric Light & Power Co., Ltd.

The profit for 1913 after paying all charges, including interest on debentures and temporary loans, but exclusive of depreciation, amounted to £922. Depreciation £300 and opposition to gas company's bill £26, leave £595 plus £2,047 brought forward, making £2,642. A dividend at the rate of 4 per cent. per annum absorbs £600, leaving to be carried forward £2,042.

The gross earnings, exclusive of profits on wiring, show a steady increase, as follows:—1911, £3,633; 1912, £4,062; 1913, £4,436. For each of these years 4 per cent. dividend has been paid. This is very satisfactory progress, but as long as the company's operations are confined to the limited area of Chesham itself any considerable increase in these figures can hardly be expected. The company has obtained provisional orders for the rural and urban districts of Hemel Hempstead, the rural and urban districts of Berkhamsted, and the rural district of Amersham, and allusion has previously been made to the necessity of carrying out the extensions which will be required to supply these districts. The time has now arrived when it is imperative to give effect to these powers, and the directors have made arrangements for the temporary financial assistance necessary for carrying out the work. The expenditure now necessary is estimated at £10,000, which will bring the capital expenditure to approximately £44,322. A considerable portion of the capital expenditure has hitherto been represented by temporary loans, bills payable and amounts outstanding on open accounts to tradesmen and others.

In order to provide a sufficient sum to discharge these liabilities, to pay for the extensions required under the new powers, and generally to place the finances of the company on a more satisfactory footing, the directors have decided to increase the present debenture issue (now standing at £10,000) by a further amount of £15,000, making the total debenture issue £25,000 bearing interest at the rate of 5 per cent. per annum. The capital expenditure on buildings, mains, plant, etc., £44,322, will constitute an ample security for this issue.

The annual meeting was held on April 17th at Hamilton House, Victoria Embankment, E.C.

Indo-European Telegraph Co., Ltd.

The annual meeting was held on Tuesday, at 18, Old Broad Street, E.C., Sir Herbert Tritton in the chair.

In proposing the adoption of the report (see Elec. Rev. p. 707), the Chairman, after referring with regret to the loss the company had sustained through the death of Baron Joh. von Berenberg Gossler, who had been a member of the board for 35 years, proceeded to review the company's operations during the past year. They had pleasure, he said, in announcing that the additional wire throughout the company's system, *viz.*, from their London station to Teheran in Persia, was now an accomplished fact. Further, this wire would shortly be linked up with an additional wire from Teheran to Karachi (to be provided by the Indo-European Telegraph Department) by the route of the Central Persian line, and the system *via* Indo would thus receive a very important addition to its carrying capacity for all classes of traffic. The traffic receipts had fallen from the very high level touched during 1912, and this was only in accordance with anticipation. Tariffs with certain places in the Far East had been reduced, and the class of "deferred" and "Press" telegrams gave ever-increasing facilities for communication in plain language at very cheap rates. He could wish that their outpayments to governments decreased in proportion. During the year under review, the managing director made a tour of inspection of the line, and they felt much indebted to him for having undertaken this arduous task. The additional wire was in course of erection, and he was able to check the rate of progress and report upon the line as altered. The work was carried out to schedule time and a minimum of disturbance was caused to the working. Mr. Wecke, the company's chief engineer in Odessa, deserved great credit for the perfection of the arrangements—no easy task when one took into account the packing, shipping, and overland transport, the facilities for which were in many cases primitive and the labour anything but skilled. Their managing director inspected the relay- and control-stations, and found the property owned by the company to be in good repair. The new maintenance offices and quarters in Odessa were substantially built and should appreciate in value. The same applied to the office and quarters built in Suchum, where they had a relay-station. Experiments were being made with new apparatus for improved automatic transmission, and so far as the experiments had gone they had proved most satisfactory. In all probability the new through wire would be equipped with this apparatus, and if the anticipated speeding-up was realized, the system would be generally adopted. Turning to wireless telegraphy—a very absorbing subject to many of them in these days—and in particular to the Galletti system, in which they were personally interested, there was no need to remind them that the directors, when this system was first brought to their notice, felt that it would not be wise on their part to ignore it, particularly having regard to the friendly attitude adopted by the French Government towards the inventor. They decided therefore to give it a full trial by forming a private company to acquire the patent rights and to carry out the necessary experiments. This company—Galletti's Wireless Telegraph and Telephone Co., Ltd.—was controlled entirely by the Indo Company, not only in direction and management, but in respect also of the proprietorship of the shares, a majority of which were, and always would be, in the hands of the Indo Company. The primary and inherent advantage claimed by the Galletti system, working as it did with continuous current, was that electric energy could be superimposed to any desired extent in order to cope with the magnitude of the task in hand, and the directors, therefore, were encouraged to work up the system to the ultimate goal, not only of transmission across the Atlantic, but of automatic reception on slip, of messages over the same distance. This was, of course, a very arduous task, and they would bear in mind that, however promising and even perfect a system might be, its adaptation to commercial purposes was necessarily a lengthy process. The choice of a high power station for transmission was practically decided for the Galletti Company by the French Government, which showed its interest in the system by placing at the disposal of Mr. Galletti not only a site on the eastern frontier of France, but an aerial complete on an exceptionally large scale, together with facilities for a full supply of continuous current at the necessary high voltage. These facilities seemed to carry them as directors of the Galletti Company far on the way to success, but they had not yet thoroughly satisfied themselves that, with the means at their disposal, they were justified in saying that they had absolutely solved the problem of automatic wireless transmission and reception by the system on a commercial basis over so long a distance as 4,000 miles (the length of the route over which they were experimenting). They had, however, thoroughly tested the system over shorter distances up to 500 miles with success. Wireless transmission, in order to be commercially useful, must not only cover long distances, but must do so at high speed and with accuracy. Those conditions were not satisfied as to reception by the use of the telephone, nor as to speed by the existing method of hand transmission. Automatic methods must therefore be used at each end. Wireless transmission by Wheatstone, Baudot, or other automatic transmitter at high speed was not such a difficult task, but the reception on slip of a current which, as received, was infinitesimal as compared with that put into the aerial, presented serious difficulties. These difficulties had been surmounted so far as they were concerned by the employment of a very ingenious and sensitive relay, which enabled them to record on slip perfect signals with a current of exceedingly low value. The Board felt that the purchase by the Galletti Company of the world's wireless rights over the relay referred to—the Orling relay—had given that company a valuable asset. Wireless telephony had also occupied attention, and good results over short distances had been attained by means of a microphone, over which an option for exclusive rights had been obtained. The directors must ask the shareholders to leave to their discretion the question of the provision of further sums for these experiments. Turning to the accounts, these showed no outstanding feature of any kind except the decrease of revenue from message and other sources already referred to. Depreciation on the company's investments during the year under review had, he regretted to say, absorbed £20,827. They would, however, be glad to learn that this had been wiped out again to a very considerable extent at the present time. The directors now proposed the usual final dividend absorbing £14,875, and bonus of 20s. per share, £17,000, both free of income tax. They also proposed to provide out of profit £30,000 for the further development of the Galletti system. They again recommended a special distribution out of interest upon certain investments and advance accounts of 15s. per share, free of tax, carrying forward £6,461 to the credit of 1914. They would probably expect him to say a few words with regard to the general prospects of the Indo Company during the year 1914. As he had already informed them, tariffs had been reduced in many directions, and though it was difficult to forecast for the complete twelve months, it looked as if those reductions, taken in conjunction with a reduction in the tariff to India from 2s. to 1s. 8d. per word, which would be in force from the 1st May, would be likely to lead to a decrease in their traffic receipts in the near future. In conclusion, he would point out that the directors had so husbanded the resources of the company that the assets as shown in the balance sheet, not only had suffered no shrinkage during the last few years, but, apart from the difficulty of depreciation of securities over which they had no control, actually showed an increase in value.

Sir William R. Brooke seconded the motion.

Replying to a shareholder, the Chairman said that the company would give early and careful consideration to the suggestion of splitting up the £25 shares of the company into £5 shares. When the £25 share was fixed upon the £5 share was hardly known. He must, however, remind the shareholders that the position was not quite so simple as it might appear at first sight, for they had a very unusual provision in the company of having shares to bearer, which were instituted at the formation of the company in accordance with Continental practice.

The report was adopted.

Calcutta Tramways Co., Ltd.

The annual meeting was held on April 22nd, at 1, Queen Victoria Street, E.C., Mr. E. C. Morgan presiding.

The Chairman, in proposing the adoption of the report (see Elec. Rev., p. 666) said that the year 1913 constituted a record in the history of the company. There had been added to the capital expenditure £6,239, which was represented by the cost of the freehold land at Shambazar acquired for the turning loop, new plant installed at the power house for lighting purposes, six new trailer cars, and sundry workshop plant. The traffic receipts made a fresh record, the increase over last year amounting to over £10,000, directly attributable to the continued steady growth of the Company's business. This excellent result was obtained despite the adverse effect of an abnormal rainfall in June. It must also be recollected that this was the first year to elapse since the transference of the Capital to Delhi. Taking next the expenditure, there was an aggregate decrease of £6,523 as compared with last year. This was due to reductions in power expenses under fuel, attributable to the general improvement in the condition of the Nonapookur plant, and under maintenance and repairs materials, consequent on the extraordinary expenditure incurred on the overhaul of the plant in the previous year. In consequence of the continued expansion of the company's business it became necessary to reinforce their feeding system in the city area, and with this object they had now put in hand, under a scheme proposed by their joint manager and chief engineer, Mr. Allen, the installation of a rotary converter sub-station at Dalhousie Square, and it was to provide for the expenditure in connection with this scheme that an opportunity was taken of issuing the balance of the 2,705 preference shares referred to in the report. The Calcutta Improvement Trust was still considering various schemes for the general improvement of the city, but they understood that no definite work had yet been decided upon.

Sir Henry Kimber seconded the motion and the report was adopted.

Replying to a vote of thanks, the Chairman said that the directors had considered the question of the interim dividend and they thought it best to keep it at its present rate, and so practically assure it, and to make the large payment at the final declaration.

STOCKS AND SHARES.

Tuesday Evening.

EVENTS abroad and in the Stock Exchange move so rapidly that prices are hard put to it to keep pace with them. So that, on one day, there may be hot and cold markets, buoyancy and flatness, cheerfulness and profound despondency. Whither the Mexican maze will lead the world at large no man pretends to do more than guess. Stock Exchange prices are at the mercy of every cablegram, and in the kaleidoscope of the Mexican situation the fertile brain of the inventive journalist in New York finds abundant scope for variegated colours.

At home the gravity of the political situation was deemed to have become so much the greater, of course, in consequence of the gun-running affair at the end of last week. The Stock Exchange politically, as everybody knows, is largely Unionist; and there was much banter of the few Liberals at the way in which the Government had been outwitted. This over, it was admitted that the challenge to the Government had complicated matters even worse than before, and a sharp fall in the price of Consols, with a good deal of pressure to sell Home Railway stocks, was the consequent financial reflection of the whole business. Rumours of an early dissolution were in circulation on Tuesday, and although discredited, they had the effect of stemming the tide of realisations.

Home Railway stocks are flat, though well above the worst, because it is argued that any open rupture in the North of Ireland would spell serious loss of traffic to the great carrying lines of this country. The investor is evidently alarmed, for he has been selling his steam stocks eagerly. With them, there have gone down the prices of the Undergrounds, Districts and Metropolitans being affected with the rest, though any through connection between the Inner Circle and Ulster it would beat even a jobber to explain. Indirectly, the tension, combined with the war fears, is tending already to bring about a hardening of discount rates in the money market, which signals to holders of all securities that they must be at least prepared to see prices go lower. London and Suburban Preference fell ½, and London United Tramways Debenture is 2 points lower.

The falls in Mexicans progress from bad to worse. Sharp rallies occurred on Monday, upon the idea that the United States, General Huerta and the Latin-American Republics might hammer out some way of peace which could be trodden by the first two. Consideration of the position, however, persuaded men that the time for shouting had not yet come. Buyers declined to be tempted into the markets, and, accordingly, prices fell back of their own weight. It will be noticed from the pages over-leaf that the slump since last we wrote has been substantial. It may be of interest—melancholy enough, truly—to compare existing quotations with those of three months ago, since the table displays, in more graphic fashion than mere word-painting can, how great has been the shrinkage in values:—

Stocks or shares.	Price. Feb. 2nd.	Now.	Fall.
Mexico Tramways Common	77½	63½	14
do. 1st Mort. Bonds	87½	73½	14
do. 6 p.c. Mort. Bonds	87	70	17
Mexican Electric Light Bonds	72	60	12
Mexican Light and Power Common	52½	37	15½
do. Preferred	87½	65½	22
do. 1st Mort. Bonds	84½	71	13½
do. 2nd Mort. Bonds	72	61½	10½
Monterey 5 p.c. Debenture	66½	50½	16

The Mexican Northern Power Company proposes to create 3 million dollars 6 p.c. prior lien 30-year gold bonds, and the terms will have to be attractive at a time like this; the Company's 5 p.c. first mortgage bonds now stand at 20 to 25.

Brazilian Tractions dropped 6, and the Preference shares fell back to 96. Para Electric Railways are steady, but falls have occurred in the bond issues of the Rio Tramways and the Sao Paulo Tramways. Canadian General Electric have been flat, and Shawinigan Water fell 2. Vera Cruz Debenture stock is nominally unchanged at 88. Kalgoorlie Electric Preference fell $\frac{3}{32}$, on the proposal to scale down the dividend from 6 per cent. to 4 per cent., and Kalgoorlie Tramways "A" Debenture stock is a point lower. This market, like the rest, is agitated and tender. The Anglo-Argentine Tramways group keeps very steady, and the chairman, at the meeting, stated that the Buenos Ayres Municipal Council had recently declined to grant any concessions for the motor-omnibus competition that had been suggested. Gross receipts for the current year, he added, showed an increase of £20,814 up to March 31st last.

In the Electric Supply group a small demand for Folkestones raised the price 10s., and Hove shares keep steady at 8¾. The London group is uninteresting; small falls in Metropolitan St. James's and Westminster Preference, with ¼ rise in London Preference, are the only noticeable changes. South Metropolitan Debenture stock moved up to the neighbourhood of par. Urban and Edmundson's both eased off to 8s. 9d. middle. A drop of 10s. in City of London Ordinary was due in part to sales by holders who required money to finance other obligations. The Rangoon Electric Tramway and Supply Company has raised its dividend from 5 per cent. to 6 per cent., and the Melbourne interim dividend is advanced from 4 per cent. to 5 per cent. for the half-year.

The Manufacturing list is noteworthy for a further rise in Brush Debenture stocks, the Firsts gaining 3 and the Seconds 1. On the other hand, Willans & Robinson Preference fell to 48½, a drop of 4 points, upon the issue of a report which the market regarded as unsatisfactory. Castner-Kellners are better to a slight extent, and the improvement in Babcock & Willcox is well held. Rubber shares receded still further with the price of the material, the latter going back to nearly half-a-crown per lb.

Marconis slumped to 2⅞ at one time, recovering later to 3, the selling having the character of forced realisations. The subsidiaries have receded as well, and the Preference shares show a loss of 10s. on the week. Anglo-American Telegraph Deferred lost ⅛, in spite of the declaration of the usual quarterly dividends on the other stocks; the Preferred stock is ¼ better. Eastern Extension Telegraphs are amongst the few to show a rise, having a gain of 5s. to their credit. West India and Panama Telegraphs second preference declined to 8¾ in consequence of the American-Mexican outbreak.

American Telephone and Telegraphs weakened on sales from across the pond. Mackay Common improved a little. The Globe issues remain very steady.

We understand that an issue of £55,000 6 per cent. First Mortgage Debentures at 99 is projected by the Jersey Electric Lighting and Power Co., Ltd.

MARKET QUOTATIONS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, April 29th.

CHEMICALS, &c.	Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric .. .. per cwt.	5/-	..
a „ Nitric .. .. „	22/-	..
a „ Oxalic .. .. .. per lb.	2⅝d.	..
a „ Sulphuric .. .. .. per cwt.	5/6	..
a Ammoniac Sal .. .. .. „	42/-	..
a Ammonia, Muriate (large crystal) per ton	£29	£1 10 dec.
a Bleaching powder .. .. .. „	£6 5	..
a Bisulphide of Carbon .. .. .. „	£18	..
a Borax .. .. „	£17 10	..
a Copper Sulphate .. .. .. „	£21 15	5s. dec.
a Lead, Nitrate .. .. .. „	£30 10	..
a „ White Sugar .. .. .. „	£28	..
a „ Peroxide .. .. .. „	£32	..
c Methylated Spirit .. .. .. per gal.	2/6	..
a Potassium, Bichromate, in casks per lb.	3½d.	..
a Potash, Caustic (88/90 %) .. per ton	£22 10	..
a „ Chlorate .. .. .. per lb.	3½d.	..
a „ Perchlorate .. .. „	3½d.	..
a Potassium, Cyanide (98/100 %) .. „ (for mining purposes only)	7½d.	..
a Shellac .. .. per cwt.	75/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	..
a Sulphur, Sublimed Flowers .. „	£8 10	..
a „ Recovered .. .. „	£5 10	..
a „ Lump .. .. .. „	£5 5	5s. inc.
a Soda, Caustic (white 70/72 %) .. „	£10	..
a „ Chlorate .. .. .. per lb.	3½d.	..
a „ Crystals .. .. .. per ton	£2 5	..
a Sodium Bichromate, casks .. per lb.	3d.	..
METALS, &c.		
b Aluminium Ingots, in ton lots .. per ton	£86	..
b „ Wire, in ton lots (1 to 14 S.W.G.) „	£107 6 8	£4 13 4 dec.
b „ Sheet, in ton lots .. „	£112	..
p Babbitt's metal ingots .. .. „	£50 to £221	..
c Brass (rolled metal 2" to 12" basis) per lb.	7¼d.	½d. dec.
c „ Tube (brazed) .. .. „	9⅜d.	..
c „ „ (solid drawn) .. „	7¼d.	½d. dec.
c „ Wire, basis .. .. .. „	7½d.	½d. dec.
c Copper Tubes (brazed) .. .. „	9½d.	½d. dec.
c „ „ (solid drawn) .. „	9½d.	½d. dec.
g „ Bars (best selected) .. per ton	£80	£2 dec.
g „ Sheet .. .. .. „	£80	£2 dec.
g „ Rod .. .. „	£80	£2 dec.
d „ (Electrolytic) Bars .. „	£66 5	£1 15 dec.
d „ „ Sheets .. „	£84 5	£1 15 dec.
d „ „ Rods .. „	£71 15	£1 15 dec.
d „ „ H.C. Wire per lb.	8¾d.	½d. dec.
f Ebonite Rod .. .. .. „	4/6	..
f „ Sheet .. .. .. „	4/-	..
n German Silver Wire .. .. „	1/10	..
h Gutta-percha, fine .. .. „	7/-	..
h India-rubber, Para fine .. .. „	2/11½	½d. dec.
l Iron Pig (Cleveland warrants) .. per ton	51/-	1d. inc.
„ Wire, galv. No. 8, P.O. qual. „	£14	..
g Lead, English Pig .. .. .. „	£19 to £19 5	10s. inc.
m Manganin Wire No. 28 .. .. per lb.	6/6	..
g Mercury .. .. per bot.	£7	..
e Mica (in original cases) small .. per lb.	6d. to 8s.	..
e „ „ „ medium „	3/6 to 6/-	..
e „ „ „ large .. „	7/6 to 11/-	..
o Nickel, sheet, wire, &c. .. .. „	3/6 to 4/6 nom	..
p Phosphor Bronze, plain castings „	1/1 to 1/3½	..
p „ „ rolled bars & rods „	1/0⅝ to 1/3	..
p „ „ rolled strip & sheet „	1/2½ to 1/5½	..
o Platinum .. .. per oz.	185/-	..
d Silicium Bronze Wire .. .. per lb.	10½d.	..
r Steel, Magnet, in bars .. .. per ton	£55	..
g Tin, Block (English) .. .. „	£158 to £159	£8 dec.
n „ Wire, Nos. 1 to 16 .. .. per lb.	2/4	..
p White Anti-friction Metals per ton	£44 to £194	..
k Zinc, Sh't (Vieille Montagne bnd.) „	£25 12 6	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

SHARE LIST OF ELECTRICAL COMPANIES.

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1912.	Dividends for 1913.	Closing Quotations April 28th.	Rise + or Fall —	Present Yield p.c.
	*					£ s. d.
Bath Trams, Pref. Ord.	1	Nil	..	⅜ — ⅝	..	Nil
Do. 5 % Pref.	1	5	5	⅞ — 1	..	6 13 4
Do. 4½ % Deb.	100	4½	4½	70 — 75	..	6 0 0
Brit. Elec. Trac., 6 % Pref.	100	..	..	15½ — 17½	..	..
Do. Do. Deferred	100	..	..	6½ — 8½	..	..
Do. Do. 6 % Cum. Pr'f.	100	6	6	89 — 92	..	6 10 5
Do. 7 % Non-Cum. Pr'f.	100	8	..	56 — 59	..	5 1 8
Do. 5 % Perp. Deb.	100	5	5	93 — 95	..	5 1 0
Do. 4½ % 2nd Deb.	100	4½	4½	79 — 83	..	5 9 9
Central London Railway, Ord.	100	3	3	57 — 62	..	4 16 9
Do. Gtd. Assented	100	..	4	83 — 84	..	4 15 3
Do. Pref.	100	4	4	68 — 73	..	5 9 7
Do. Gtd. Assented	100	..	4	83 — 85	..	4 14 8
Do. Def.	100	2	2	40 — 45	..	4 9 0
Do. Gtd. Assented	100	..	4	80 — 83	..	4 17 7
Do. 4 % Deb.	100	4	4	97 — 99	..	4 0 10
City & S. London, 5 % Pref., 1891	100	5	5	95 — 97	..	5 3 1
Do. Do. 1896	100	5	5	91 — 94	..	5 6 5
Do. Do. 1901	100	5	5	89 — 92	..	5 8 8
Do. Do. 1903	100	5	5	89 — 92	..	5 8 8
Do. 4 % Deb.	100	4	4	88 — 90	..	4 9 0
Hastings Trams, 6 % Pref.	1	6	6†	⅜ — ½	..	8 0 0
Do. 4½ % Deb.	100	4½	4½	65 — 70	..	6 8 7
Isle of Thanet Trams, 5 % Pref.	5	2½	3	2 — 2½	..	6 0 0
Do. 4 % Deb.	100	4	4	73 — 78	..	5 2 7
Lancashire United, 5 % Deb.	100	5	5	87 — 89	..	5 12 4
London and Suburban, Ord.	1	..	..	⅛ — ⅜	..	..
Do. Do. 5 % Cum. Pref.	1	..	5†	½ — ⅝	−⅛	8 0 0
Do. Do. 4½ % 1st Deb.	100	4½	4½	78 — 83	..	5 8 5

NAME.	Stock or Share.	Dividends for 1912.	Dividends for 1913.	Closing Quotations April 28th.	Rise + or Fall —	Present Yield p.c.
	*					£ s. d.
London Elec. Railways, 4 % Deb.	100	4	4	90 — 92	..	4 7 0
London United Trams, 4 % Deb.	100	4	4	56 — 60	−2	6 13 4
Metropolitan Railway Consol.	100	1⅜	1⅜	39⅜ — 40½	−2	4 0 9
Do. Surplus Lands	100	2⅜	2⅜	63 — 65	..	4 4 7
Do. 3½ % Deb.	100	3½	3½	87 — 89	..	3 18 7
Do. 3½ % Pref.	100	3½	3½	82 — 84	..	4 3 4
Do. 3½ % Con. Pref.	100	3½	3½	80 — 82	..	4 5 4
Metropolitan District Ord.	100	Nil	..	26½ — 27	−½	Nil
Do. 6 % Deb.	100	6	6	138 — 141	..	4 5 1
Do. 4 % Deb.	100	4	4	93 — 95	..	4 4 8
Do. 4 % Prior Lien	100	4	4	97 — 99	..	4 0 10
Do. 4½ % First Pref.	100	4½	4½	84 — 87	..	5 3 6
Do. 3½ % Gtd.	100	3½	3½	74 — 76	..	4 12 1
Metro. Elec. Trams, 4½ % Deb.	100	4½	4½	88 — 91	..	4 17 9
Do. 5 % Deb.	100	5	5	85½ — 88½	..	5 13 0
Potteries, Ord.	1	3½	..	⅜ — ½	..	..
Do. 5 % Pref.	1	5	5	3/16 — 3/8	..	7 12 8
Do. 4½ % Deb.	100	4½	4½	84 — 87	..	5 3 6
South Metro. Trams, 6 % Pref.	1	6	6†	⅜ — ½	..	8 0 0
Do. 4 % Deb.	100	4	4	66 — 70	..	5 14 4
Underground Elec. Railways	10	..	..	3 — 3½	— ⅛	Nil
Do. "A"	1/-	..	..	1/16 — ⅛	..	Nil
Do. 6 % First Cum. Inc. Deb.	100	6	6	114 — 116	+ 2	5 3 5
Do. 4½ % Bonds	100	4½	4½	99⅝ — 101⅛	..	4 8 8
Do. 6 % Income	100	6	6	89 — 90	−1	6 13 4
Yorkshire (West Riding). Ord.	5	Nil	..	5/16 — 7/16	..	Nil
Do. 6 % Pref.	5	3	4	4⅛ — 4⅝	+ ⅛	4 2 8
Do. 4½ % Deb.	100	4½	4½	84 — 87	+1	5 3 6

ELECTRIC RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5½	5½	4⅝ — 4¾	..	5 12 10
Do. 2nd Pref.	5	5½	5½	4⅝ — 4¾	..	6 0 7
Do. 4 % Deb.	100	4	4	92½ — 94½	..	4 4 8
Do. 4½ % Deb.	100	4½	4½	98½ — 101½	+ ½	4 8 6
Do. 5 % Deb.	100	5	5	96½ — 98½	..	5 1 6
Auckland Trams, 5 % Deb.	100	5	5	103 — 106	..	4 14 3
Bombay Elec. S. & Trams, Pref.	10	6	6	10⅜ — 11⅜	..	5 4 4
Do. 4½ % Deb.	100	4½	4½	94½ — 96½	..	4 13 3
Do. 5 % 2nd Deb.	100	5	5	98 — 100	..	5 0 0
Brazilian Traction, Light and Power	$100	6	6†	77 — 79	−6	7 12 0
Brisbane Trams Invt., Ord.	5	8	8	7⅞ — 8	..	5 0 0
Do. 5 % Pref.	5	5	5	4⅞ — 5⅛	..	4 13 0
Do. 4½ % Deb.	100	4½	4½	98 — 101	..	4 9 1
B. Columbia Elec. Rly., Def.	100	8	8†	116 — 120	..	6 12 4
Do. Pref. Ord.	100	6	6	104 — 108	−1	5 11 1
Do. 5 % Pref.	100	5	5	101 — 105	..	4 15 2
Do. 4½ % 1st Mort. Deb.	40	4½	4½	96 — 99 xd	..	4 11 1
Do. 4½ % Vancouver Deb.	100	4½	4½	91 — 93	..	4 12 0
Do. 4½ % Con. Deb.	100	4½	4½	93½ — 95½	..	4 9 1
Calcutta Trams, Ord.	5	7½	9½	7 — 7½	..	6 6 8
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	97 — 100	..	4 10 0
Cape Electric Trams	1	5	5	⅝ — ¾	..	6 18 4
City Buenos Aires Trams (1904)	5	5	5	5⅛ — 5⅜	..	4 10 11
Do. 4 % Deb.	100	4	4	91 — 96	..	4 8 4
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	89 — 93	..	5 7 8
Havana Elec. Rly., 5 % Bonds	$1000	5	5	93½ — 97½	..	5 2 6
Kalgoorlie Elec. Trams	1	N	..	0 — 1/16	..	Nil
Do. 5 % A Deb.	100	5	5	84 — 89	−1	5 12 4
Do. 6 % B Deb.	100	8	..	10 — 20	..	Nil

La Plata Elec. Trams, Ord.	1	..	..	⅛ — ¼	..	..
Do. Pref.	1	4½d.	6	¾ — 1	..	8 0 0
Lisbon Elec. Trams, Ord.	1	6	6†	1⅛ — 1⅜	..	4 7 8
Do. 6 % Pref.	1	6	6	1⅛ — 1 3/16	..	5 1 0
Do. 5 % Deb.	100	5	5	95 — 100	..	5 0 0
Madras Elec. Tr., 6 % Cum. Pref.	5	6	6	4½ — 5½	..	5 14 3
,, Elec. Tr. (1904), Deb.	100	5	5	101 — 103	..	4 17 0
Manaos Trams & Lt., 1st Deb.	100	5	5	78 — 81	−1	6 3 5
Manila Elec. R. and Ltg., Bonds	$1000	5	5	98½ — 100½	..	4 19 6
Mexico Trams Com	$100	7	7	61 — 66	−5	..
Do. Gen. Con. 5 % Bonds	..	5	5	71 — 76	−3½	6 11 7
Do. 6 % Bonds	100	6	6	67½ — 72½	−12½	8 5 6
Para Elec. Rlys. & Lt., Ord.	5	10	10	8¼ — 8⅝	..	11 8 6
Do. 6 % Pref.	5	6	6	4 — 4½	..	6 13 4
Do. 5 % 1st Deb.	100	5	5	89 — 92	..	5 8 8
Rangoon El. Tr. & Sup., Pref.	5	6	6	5 — 5½	..	5 9 1
Do. 4½ % 1st Deb.	100	4½	4½	95 — 97	..	4 12 9
Rio de Janeiro Trams, 1st Mort. 5 % Bonds	..	5	5	96 — 98	−1	5 2 0
Do. 5 % Mort. Bonds	100	5	5	83½ — 91	−½	5 10 0
Sao Paulo Tram., Lt. and P. 5 % 1st Deb.	$500	5	5	96 —100	−1½	5 0 0
Singapore Trams, 5 % Deb.	100	5	5	83 — 92	..	5 8 8
Southern El. Tr. B.A., 5 % Deb.	100	5	5	95 — 97	..	5 3 0
Un. Elec. Trams Monte Video	5	7	7	4⅜ — 5⅛	..	6 16 7
Do. 6 % Pref.	5	6	6	4⅜ — 5⅛	..	5 14 3
Do. 5 % 1st Deb.	100	5	5	95 — 98	..	5 2 0
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	93½ — 95½	..	4 14 3

ELECTRICITY SUPPLY AND POWER COMPANIES.—HOME.

Bournemouth & Poole, Ord.	10	6	7	10 — 11	..	6 7 4
Do. 4½ % Pref.	10	4½	4½	9 — 10	..	4 10 0
Do. Second 6 % Pref.	10	6	6	10⅜ — 10⅞	+ ⅛	5 10 4
Do. 4½ % Deb. Stock	Stock	4½	4½	95 — 98	..	4 11 9
Brompton & Kensington, Ord.	5	10	10	8⅜ — 9½	..	5 8 1
Do. 7 % Cum. Pref.	5	7	7	8¼ — 8⅜	..	4 0 0
Central Electric Supply, 4 % Guar. Deb.	100	4	4	91½ — 94½	..	4 4 8
Charing Cross, West End & City	5	5	6	4⅞ — 5⅛	..	5 11 7
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 5	..	4 10 0
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	4½ — 4¾	..	5 0 0
Do. Do. 4 % Deb.	100	4	4	93 — 94	..	4 5 1
Chelsea, Ord.	5	5	5	4⅞ — 5	..	5 0 0
Do. 4½ % Deb.	Stock	4½	4½	97 — 100	..	4 10 0
City of London, Ord.	10	9	10	16 — 17	— ⅛	5 17 8
Do. 6 % Cum. Pref.	10	6	6	12⅜ — 13⅜	..	4 7 3
Do. 5 % Deb.	Stock	5	5	116 — 120	..	4 7 4
Do. 4½ % Second Deb.	100	4½	4½	100 — 103	..	4 8 1
County of London, Ord.	10	6	7	11⅜ — 12⅛	..	5 14 3
Do. 6 % Pref.	10	6	6	11⅜ — 12⅛	..	4 19 0
Do. 4½ % Deb.	Stock	4½	4½	103 — 106	..	4 5 3
Do. 4½ % Second Deb.	Stock	4½	4½	100 — 103	..	4 7 5
Edmundson's, Ord.	£3	..	..	1/16 — 1/8	—1/16	Nil
Do. 6 % Cum. Pref.	5	6	6	3⅝ — 4¼	..	7 1 2
Do. 6 % Non-Cum. Pref.	5	..	..	1⅜ — 2	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	84 — 87	..	5 3 6
Folkestone	5	6	6	4⅞ — 5⅜	+ ⅛	5 11 7
Do. 5 % Cum. Pref.	5	5	5	4½ — 4⅞	..	5 5 3
Do. 4½ % First Deb.	100	4½	4½	93 — 95	..	4 14 9

Hove	5	8	9	8½ — 9	..	5 0 0
Kensington & Knightsbridge, Ord.	5	8	9	7⅝ — 8	..	5 12 0
Do. 4 % Deb.	Stock	4	4	90 — 92	..	4 7 0
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	76 — 80	..	5 12 0
London Electric, Ord.	3	2½	3	1⅜ — 1⅝	..	5 2 7
Do. 6 % Pref.	5	6	6	4⅞ — 5⅛	+ ⅛	5 14 8
Do. 4 % First Mort. Deb.	Stock	4	4	92 — 95	..	4 4 1
Metropolitan	5	4½	4½	3½ — 3⅝	— ⅛	6 0 0
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 5	..	4 10 0
Do. 4½ % First Mort. Deb.	Stock	4½	4½	97 —100	..	4 10 0
Do. 3½ % Mort. Deb.	Stock	3½	3½	83 — 86	..	4 1 4
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	98 —101	..	4 19 1
Notting Hill, 6 % Non-Cum. Pref.	10	6	6	9⅜ — 10⅛	..	5 14 3
Oxford	5	7	7	5⅞ — 6⅛	..	5 11 0
St. James' and Pall Mall, Ord.	5	10	12	9⅛ — 9⅜	— ⅛	6 4 8
Do. 7 % Pref.	5	7	7	6⅝ — 7⅛	..	4 18 3
Do. 3½ % Deb.	100	3½	3½	83 — 86	..	4 1 4
South London, Ord.	4	5⅓	5⅓	2⅜ — 2⅝	..	6 10 4
Do. 5 % First Mort. Deb.	100	5	5	98 —101	..	4 19 0
South Metropolitan, 7 % Pref.	1	7	7	1⅝ — 1⅞	..	5 6 8
Do. 4½ % First Deb. Stock	100	4½	4½	97 — 100	+2½	4 10 0
Urban, Ord.	£3	Nil	..	5/16 — 3/8	—1/16	..
Do. 5 % Cum Pref.	5	3½	4	2⅜ — 2½ xd	..	6 13 4
Do. 4½ % First Mort. Deb.	100	4½	4½	85 — 88	..	5 12 3
Westminster, Ord.	5	10	10	8¼ — 8⅜	..	5 14 3
Do. 4½ % Cum Pref.	5	4½	4½	5 — 5½	—⅛	4 5 9

* Unless otherwise stated, all shares are fully paid. † Interim Dividend. ‡ And Funded Certs.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

ELECTRICITY SUPPLY AND POWER—COLONIAL AND FOREIGN.

NAME.	Stock or Share.	Dividends for		Closing Quotations April 28th.	Rise + or Fall —	Present Yield p.c.
	*	1913.	1913.			£ s. d.
Adelaide, 6 % Pref.	£	6	6	5⅛ — 5⅝	..	5 11 7
Calcutta, Ord.	£	8½	6†	7⅝ — 8	..	5 6 8
Do. 6 % Pref.	£	5	5	4¹⁵⁄₁₆ — 5⅛	—1/16	4 16 8
Calgary Power, 1st Mort. Bds.	100	5	5	90½ — 92½	..	5 8 0
Canadian Gen. El. Com.	$100	7	8	103 — 108	—5½	7 8 2
Do. 7 % Pref.	$100	7	7	117 — 122	—1	5 13 10
Cordoba Lt., Power and T., Ord.	1	5	..	⅞ — 1	..	7 12 0
Do. 5 % Deb.	100	5	5	87 — 90	..	5 11 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	87 — 89	..	6 14 10
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	91 — 94	..	5 6 5
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	98¼ - 99½	..	5 4 9
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	⅛ — ⅜	..	Nil
Do. 6 % Pref.	£	6	6†	⅞ — 1⅛	—1/16	5 12 4
Kaministiquia Power, 5 % G. Bs.	$500	5	5	102 —104	..	4 16 2
Madras, Ord.	£	Nil	..	1½ — 1⅝	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	104 — 107	+ ½	4 13 6
Mexican El. Lt., 5 % 1st M. Bds.	£	5	5	57⅛ — 62½	—5/8	8 0 0
Mexican Lt. & Power, Common	$100	4	4†	35 — 39	— 2	..
Do. 7 % Cum. Pref.	$100	7	7	63 — 68	- 6½	10 5 10
Do. 5 % 1st Mort. Gold Bds.	£	5	5	68½ — 73½	—6½	6 16 1
Do. 5 % 2nd Mort. Bonds	100	5	5	59 — 64	—1½	7 16 4
Monterey Rly., Light & Power, 5 % 1st Mort. Deb.	100	5	5	48 — 53	—4	..
Montreal, Lt., H. and Power	$100	9	10†	223 - 228	..	4 7 9
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5a	5a	10 — 20	..	..
River Plate, Ord.	Stock	10	..	245 - 255	..	3 18 5
Do. 6 % Non-Cum. Pref.	Do.	6	6	103 - 108	..	5 11 1
Do. 5 % Deb. Stock	Do.	5	5	101 - 103	..	4 17 0
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	100 —102	..	4 8 3
Shawinigan Water, Capital	$100	5½	6	131 - 135	—2	4 9 0
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	107 —109	..	4 11 7
Do. 4½ % Per. Deb.	Stock	4½	4½	101½ - 103½	..	4 7 0
Toronto Power, 4½ % Deb.	Do.	4½	4½	95 — 97	— ½	4 12 9
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	87 — 89	..	5 12 4
Victoria Falls Power, Pref.	1	6	6	8⅜ — 8⅝	..	7 18 4
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	102 —104	..	5 15 5

MANUFACTURING COMPANIES.

NAME.	Stock or Share.	Dividends for		Closing Quotations April 28th.	Rise + or Fall —	Present Yield p.c.
	*	1913.	1913.			£ s. d.
Aron, Ord.	£	7	..	3⅜ — 3⅞	..	8 5 0
Do. 6 % Pref.	£	6	6	⅜ — ½	..	6 17 2
Babcock & Wilcox	£	16	16	3⅛ — 3⅜	..	5 1 5
Do. Pref.	£	6	6	1⅝ — 1⅞	..	4 8 6
British Aluminium, Ord.	£	..	5	⅝ — 1⅜	..	4 11 4
Do. 6 % Cum. Pref.	£	6	6	⅞ — 1	..	6 8 0
Do. 5 % Prior Liens Debs.	100	5	5	96 — 99	..	5 1 0
Do. Deb. Stk.	100	5	5	88 — 93	..	5 7 6
B.I. & Helsby Cables	£	10	13	9½ — 9⅝	..	6 13 4
Do. Pref.	£	6	6	5⅝ — 6⅛	..	4 14 1
Do. Deb.	100	4½	4½	101 —104	..	4 6 9
British Thomson-Houston, Deb.	100	4½	4½	92 — 94	..	4 15 9
British Westinghouse, Pref.	£	Nil	5	1⅝ — 1¾	..	6 13 4
Do. Deb.	100	4	4	73 — 75	..	5 6 8
Do. 6 % Prior Lien	100	6	6	100 —103	..	5 16 6
Browett, Lindley, Ord.	£	..	..	2/- —3/-	..	Nil
Do. Pref.	£	..	..	8/- —8/6	..	Nil
Brush, 7 % Pref.	£	Nil	..	0 — ¼	..	Nil
Do. 5 % Prior Lien Deb.	100	5	5	80 — 85	..	5 17 8
Lo 4½ % Deb.	100	4½	4½	49 — 53	+3	8 10 0
Do. 4½ % Second Deb.	100	4½	4½	29 — 33	+1	13 12 8
Callender's Cable	£	15	5†	11⅜ — 12⅛	..	6 0 0
Do. Pref.	£	5	5	5 — 5¼	..	4 16 5
Do. Deb.	100	4½	4½	97 —100	..	4 10 0
Castner-Kellner	£	20	22½	23⅜ — 23⅞	+3/32	7 18 2
Do. Deb.	100	4½	4½	104 —107	..	4 4 1
Crompton & Co., Deb.	100	5	5	88 — 85	..	5 17 8
Dick, Kerr	£	Nil	..	⅜ — ½	..	..
Do. Pref.	£	6	6	¾ — ⅞	..	7 13 4
Edison & Swan, A, £2 paid	£	Nil	..	0 — ⅛	..	Nil
Do. fully paid	£	Nil	..	1 — 1⅛	..	Nil
Do. 4 % Deb.	100	4	4	58 — 62	..	6 9 1
Do. 5 % Second Deb.	100	5	5	62 — 67	..	7 9 1
Electric Construction	£	1	5	1⅞ — 2⅛	..	7 12 6
Do. Pref.	£	1	7	1⅝ — 1⅞	..	6 11 7
Greenwood & Batley, Pref.	£	10	7	6⅞ — 7½	..	9 13 2
Do. Deb.	100	5	5	92 — 94	..	5 6 5
General Electric, 6 % Pref.	£	10	6	10¼ — 10½	..	5 14 3
Do. Deb.	100	4	4	85 — 89	..	4 10 0
Henley's, Ord.	£	15	20	13½ — 14½	..	6 17 11
Do. Pref.	£	4½	4½	4⅛ — 5⅛	..	4 9 0
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
India-Rubber, G. & T.	£	10	7½	10¼ — 11½	..	6 10 5
Do. Pref.	£	10	5	8½ — 9½	..	5 5 3
Telegraph Construction	£	12	20	36 — 38	..	6 6 7
Do. Deb.	100	4	4	98 — 100	..	4 0 0
Willans & Robinson, 4 % 1st Mort. Deb.	100	4	4	64 — 68	..	5 17 8
Do. B 4 % Cum. Pref.	100	..	..	46 — 51	—4	..

TELEGRAPH AND TELEPHONE COMPANIES.

NAME.	Stock or Share.	Dividends for		Closing Quotations April 28th.	Rise + or Fall —	Present Yield p.c.
	*	1913.	1913.			£ s. d.
Amazon Telegraph	£	4½	4½	5⅝ — 6½	..	7 4 0
Do. 5 % Deb. Red.	Stock	5	5	94 — 97	..	5 3 0
American Telep. & Teleg., Cap.	$100	8	8	121 —125	—2½	6 8 0
Do. Collat. Trust	$1000	4	4	90 — 93	— 2	4 6 0
Anglo-American Telegraph	Stock	3	3	64 — 67	..	4 9 7
Do. 6 % Pref.	Do.	6	6	109⅜ - 110⅜	+ ⅛	5 8 7
Do. Def.	Do.	80/-	80/-	28⅛ — 28⅝	— ⅛	6 7 9
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	102 —104	— ⅜	4 16 2
Chili Telephone	£	8	..	7⅞ — 7⅞	..	5 5 0
Commercial Cable, Stlg. 4 % Deb.	Stock	4	4	80 — 82	— ½	4 17 7
Cuba Telegraph	£	10	6†	8⅜ — 9⅜	..	6 8 1
Do. 10 % Pref.	£	10	10	15⅜ — 16⅜	..	5 19 5
Direct Spanish Telegraph, Ord.	£	4	4	8¼ — 4	..	5 0 0
Do. 10 % Cum. Pref.	£	10	10	7⅛ — 8	..	6 5 0
Direct United States Cable	£	10	4	6⅜ — 7⅛	..	5 12 4
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	97 — 99	..	4 10 10
Eastern Telegraph, Ord. Stock	£	7	7	188 —186	..	5 3 0
Do. 8½ % Pref. Stock	Do.	8½	8½	77⅛ — 79½	..	4 8 1
Do. 4 % Mort. Deb.	Do.	4	4	96 — 98	..	4 1 8
Eastern Extension	£	7	7	12⅜ — 13⅛	+ ⅛	5 5 9
Do. 4 % Deb.	Stock	4	4	94½ — 96½	..	4 3 0
Globe Telegraph and Trust	£	10	6†	11 — 11½	..	5 4 4
Do. 6 % Pref.	£	10	6	12½ — 13	..	4 12 4
Great Northern Telegraph	£	20	20	30½ - 32½ xd	..	6 8 1
Indo-European Telegraph	£	25	13	58½ - 60½	..	5 7 4
Mackay Companies Common	$100	5	5	86 — 89	+1	5 12 4
Do. 4 % Cum. Pref.	$100	4	4	70 — 73	..	5 9 7
Marconi's Wireless Telegraph	£	20	20	2⅛ — 3⅛	—1/16	6 10 6
Do. 7 % Cum. Partic. Pref.	£	17	..	2⅛ — 2⅜	—⅛	6 3 8
Monte Video Telephone, Ord.	£	6	6	⅛ — ⅜	..	6 8 0
Do. 5 % Pref.	£	5	5	⅛ — ¼	..	5 14 3
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	100 —101	..	4 9 0
Oriental Telep. and Elec.	£	10	10	2⅜ — 2⅝	..	4 4 3
Do. 6 % Cum. Pref.	£	6	6	1⅜ — 1⅝	..	4 11 5
Do. 4 % Red. Deb.	Stock	4	4	87½ - 89½	..	4 9 5
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	98 - 100	..	4 0 0
Reuter's	£	10	10	8 — 9	..	11 2 2
Submarine Cables Trust	Cert.	6	6	125 —128 xd	..	4 13 9
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	98 - 100	..	4 10 0
United River Plate Telephone	£	8	6†	6⅜ — 6⅞	..	5 16 5
Do. 5 % Cum. Pref.	£	5	5	5⅛ — 5⅜	..	4 9 0
West Coast of America	£	2½	..	1⅞ — 1⅞	..	4 8 0
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	96 — 99	..	4 0 10
West India and Panama Teleg.	£	10	1½	1½	2⅛ — 2⅛	..	5 2 7
Do. 6 % Cum. 1st Pref.	£	10	6	6	9⅜ — 10⅜	..	5 18 5
Do. 6 % Cum. 2nd Pref	£	10	6	6	8⅜ - 9⅜	— ⅛	6 11 6
Do. 5 % Debs.	100	5	5	5	96 — 99	..	5 1 0
Western Telegraph, Ltd.	£	10	7	7	13⅜ - 13⅞	..	5 1 11
Do. 4 % Debs.	Stock	4	4	95½ — 97½	..	4 2 1
Western Union 4½ % Fdg. Bonds	$100	4½	4½	95 — 98 xd	..	4 11 1

* Unless otherwise stated all shares are fully paid. † Interim dividend. a Paid in deferred interest warrants.

Bank rate of Discount 3 per cent., January 29th, 1914.

Motor-Starters.—Referring to the abstract in our issue of the 24th ult. of the paper read by Mr. E. F. Butler before the Junior Institution of Engineers, on the subject of motors and motor control, the Igranic Electric Co., Ltd., express entire agreement with his remarks on the subject of damage caused to starter contacts by the operator often moving his lever on to the first step and then drawing it back, and so causing destructive sparking. The remedy which Mr. Butler puts forward, they say, although a useful one on starters already supplied, precludes the use of an overload release, and also the arrangement is not fool-proof, it being possible for the operator to leave the lever in the lowest speed position and so burn out the resistance. The company have devoted a considerable amount of time and experiment to this particular subject, and claim that their patent arc-preventing interlock renders starting fool-proof and reliable. All circuit-making and breaking is accomplished on magnetically-operated circuit-breakers specially designed for this service, and they are enabled to use an overload release device which allows the operator to start the motor with all the advantages of a loose-handle circuit-breaker. The fact that they have a very large and increasing demand for this type of starter proves that the electrical industry is aware of the advantages offered by such a device.

THE LAND AND THE ELECTRICAL INDUSTRY.

By JOS. J. H. STANSFIELD.

At the instance of a Committee appointed by the Chancellor of the Exchequer, two volumes have been published as the result of an enquiry made in the years 1912-13 to obtain "an accurate and impartial account of the social and economic conditions in the rural parts of Great Britain," and a knowledge of the "nature and working of the existing systems of ownership, tenancy and taxation, and the rating of land and buildings in urban districts and the surrounding neighbourhoods, and their effect on industry and the conditions of life."

The object of the enquiry was confessedly of a political character, and so far as such object is concerned we have not, as persons engaged in connection with the supply of electrical energy, any direct interest, but in view of the possibility of legislation being based upon the conclusions arrived at by the Committee, it is not inopportune to consider such portions of the second volume dealing with the urban parts of Great Britain as touch upon matters of moment to the electrical industry, and endeavour to see how far any proposals made will affect the future.

The first volume treats exclusively of the rural part of Great Britain, and the evidence it contains and the conclusions arrived at are not of such great moment as those dealt with in the second volume. When we are on holiday bent the country has its attractions, but in our work-a-day times we are much more interested in mills than in hills, and generating rather than railway stations claim our closer attention.

The second volume is a book of over 700 pages, and whilst there is much that is mainly interesting to the politician and the student of social problems and conditions, there are a number of subjects dealt with that should not be overlooked whatever particular brand of politics we may affect. The most important of these to members of the electrical profession are as follows:—

The Acquisition of Land.

Part II of Volume II deals with the acquisition of land by public and quasi-public bodies in urban and rural areas, particularly where such acquisition is by virtue of compulsory powers.

A statutory body which seeks to obtain compulsory powers to acquire land for a public undertaking may proceed in several ways: (1) by Act of Parliament, (2) by Provisional Order of a Government Department (confirmable by Parliament), (3) by Provisional Order confirmable by a Government Department, and (4) by resolution of the local authority without any further confirmation being needed.

Under the Electric Lighting Acts, 1882 to 1899, the policy has been against the acquisition of land by compulsory powers, but land may be acquired by agreement in the case of companies unlimited as to quantity (except where transfer to a local authority is intended), and in the case of local authorities limited to five acres.

A Joint Committee of the two Houses of Parliament considered in 1898 whether compulsory powers should be given to electrical undertakers, but it was not until the passing of the Electric Lighting Act of 1909 that such powers could be obtained without an application to Parliament for the granting of a special Act.

Where, as in the case of Power Companies, an application to Parliament has been made, the special Act has incorporated the whole or part of the Lands Clauses Acts in respect of the sites scheduled in the Act for the erection thereon of generating stations.

The procedure almost universally employed in assessing compensation is laid down by the Lands Clauses Consolidation Act of 1845, and the Amending Acts of 1860, 1869, 1883 and 1895, and the practice that has grown up under these has been summed up by Mr. F. W. Hunt in a paper read at the Surveyors' Institution in 1912 under five heads: (1) the lands to be taken are restricted to what are actually required for the undertaking, (2) an owner is entitled to be paid the value of the property to him at the time of the enquiry, and compensation for damage due to the taking of the lands, irrespective of any benefit he may, in respect of other lands belonging to him, obtain by the execution of the works, (3) a percentage is added to the sum awarded as compensation for the value of the land taken, amounting to at least ten per cent., (4) the claimant has the right of selecting the tribunal to settle the case in the event of no agreement, including the right to a jury, which under the Act is the normal tribunal, and (5) an owner cannot be compelled to sell part of a house, manufactory or other building, if he is able and willing to sell the whole.

It is natural that there should be much difference of opinion as to whether the prices usually paid for land compulsorily acquired are reasonable or not, but the main reason for the large prices often paid appears to be due to the fact that it is the value of the land to the owner that is the subject of compensation, and not merely the market value or its value to the promoters taking it.

The tendency of later legislation has been to narrow the basis of compensation by fixing the fair market value without any addition for compulsory purchase, sometimes embodying the principle of betterment as in the Light Railways Act of 1896, where the arbitrator, in determining the amount of compensation, "shall have regard to the extent to which the remaining and contiguous lands and hereditaments belonging to the same proprietor may be benefitted by the proposed light railway."

From the statements quoted in the book there appears to be on the whole a general idea that the present methods of obtaining land are cumbrous, dilatory and expensive, and certain recommendations are made, the most important being as follows:—(1) except in cases of schemes of great magnitude or novelty recourse to Parliament should be unnecessary, (2) compensation should be paid for damage due to severance and disturbance, (3) no addition should be made for compulsory purchase, (4) the basis of compensation should be the market value if sold by a willing seller assessed on the principles laid down in the Finance (1909-10) Act, 1910, (5) no allowance should be made for injurious affection to other lands, and no deductions should be made for "betterment," (6) promoters should be able to take part only of land or buildings, (7) local authorities should be able to purchase land for future use (companies usually find no difficutly in obtaining this power), and (8) the tribunal for assessment of compensation should be a new body to be called the Judicial Land Commissioners.

Easements and Wayleaves.

During recent years considerable progress has been made in the erection of overhead lines for the purpose of distributing electrical energy, and that portion of the book dealing with easements and wayleaves is therefore of particular interest and importance.

The Committee, in reporting, say that "modern developments of the use of electricity to supply power at a distance from the spot where it is generated have given increased importance to this question. Wires have to be carried across country, and each owner whose land it is proposed to traverse is enabled to hold the scheme up by demanding an excessive price for permission to carry the wires across his land. In some cases he is enabled to prevent it altogether."

An instance of difficulty having been experienced

is given where the Bury Corporation endeavoured to obtain a wayleave to carry an overhead electric wire across certain agricultural land in order to supply power to an adjoining urban district. There would have been six poles on the land, and the owner demanded an annual payment of £5 per pole, but afterwards refused to grant facilities at any price, compelling the Corporation to expend an additional £1,000 in order to get round the forbidden area.

Most of those persons who are concerned in obtaining easements and wayleaves can add instances where prohibitive prices have been quoted, and an Act dealing with those matters would undoubtedly be a boon.

Gas, water, and electrical undertakers usually have powers to break up streets, repairable by the local authority, where the laying of underground pipes or mains is desired, and electrical undertakers either schedule other streets to be broken up in the Provisional Order, or can make an application to the Board of Trade for the necessary powers where the streets are dedicated to the public.

The difficulties mainly arise where mains are to be laid in or over private property where the consent of both owner and occupier is necessary, and in the case of companies, the consent of the local authority also.

In the case of unreasonable refusal by a rural district authority to consent to overhead lines, power companies have usually an appeal to the Board of Trade, but other authorities have an absolute veto, and sometimes do not hesitate to exercise it even where no public streets would be crossed.

The Committee recommend that the Government Department authorised to sanction the Order should have the power to make an order for the compulsory acquisition of easements and wayleaves; that the terms should be fixed by the Judicial Land Commissioners, and that the consent of the local authority should be necessary in the case of boroughs and urban districts of more than 10,000 population.

With regard to the consent of the local authority being required, the writer is of opinion that the local authority should only have a reasonable veto. It is only just that the Government and quasi-public companies should be protected in case of arbitrary refusals. Little hesitation is shown in making regulations for the safety and protection of the public, and as a *quid pro quo* some slight assistance might be given to those who are legitimately carrying out duties conferred upon them by Parliament.

In several continental countries legal facilities exist by which compulsory wayleaves can be obtained where necessary, as a result of which standard prices have gradually become established, and agreements are usually arrived at without any necessity to have recourse to the officials authorised to grant compulsory powers.

Copyholds, Short Leaseholds, &c.

An instructive and interesting part of the report deals with the various current forms of tenure with their area of distribution.

From time to time it is necessary to obtain land for the erection thereon of generating and sub-stations. It is not always possible to purchase outright, and careful consideration is necessary where a local distributive system is laid in connection with a sub-station where the lessor can sooner or later require an amendment of the conditions of a lease.

The Committee are averse to compulsory powers being granted to convert leaseholds into freeholds, except in the case of leases to religious bodies and to local authorities, their principal recommendations being:—(1) that after a certain interval all copyholds shall become freehold, (2) that "life leases" shall be prohibited, and (3) that the Judicial Land Commissioners shall be empowered to extend leases, amend their terms, and assess compensation payable in respect thereof.

Rating.

Considerable space is devoted to the question of rating, and recommendations are made in respect of amendments in both law and practice.

The present system of assessment is cumbrous, and in the case of authorities operating over large areas, often unsatisfactory. The Committee state that in the case of railways, canals, mines, tramways, docks, telephones, gas, water, and electric light works, they agree with the conclusion of the Royal Commission in their Final Report in 1901, where they recommend that an independent assessor should be appointed by the Government, who should value all such properties.

They make no recommendations as to an alteration in the method of valuing such undertakings for rating purposes, their principal suggestion being that site values should be rated, and that all future expenditure in any given rating area should be met by a rate upon site values instead of upon the value of the composite hereditament.

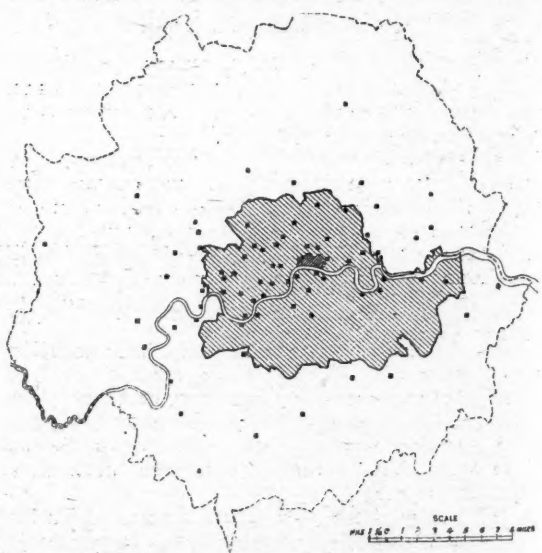
LONDON ELECTRICITY SUPPLY.

Messrs. Merz and McLellan's Report Summarised.

(*Concluded from page* 688).

As regards competition, if a new undertaking were established by public authority or company to supply in bulk for power and heating, but not for lighting, progress would be more rapid, both in districts where competition took place and indirectly; if a new and comprehensive undertaking were established covering the greater London area, with full powers of competition for all classes of supply, it is considered probable that the price of electricity would immediately fall and developments of heating and cooking follow rapidly.

Although no monopoly was granted, yet it might be necessary to postpone the date of purchase of existing companies or arrange for them to be taken over, and the municipal concerns would have to be specially dealt with. Amalgamation of existing undertakings would provide the most certain method of bringing about concentration of production and unification of distribution, but experience has shown that amalgamation of private undertakings by public authorities is unsatisfactory. It is uncertain how the terms of purchase of the London companies will be interpreted. The conclusion is that the only satisfactory solution is the establishment of a new under-



Generating Stations in the County of London and Greater London.

taking with such powers as will enable it to concentrate production, standardise and unify distribution, and bring about amalgamation of the various undertakings; this is recommended as opposed to the establishment of an undertaking prohibited from associating with or from competing against the existing undertakings, provided their co-operation can be secured. This policy does not necessarily involve any immediate interference with the Council's rights of purchase in 1931. Assuming the necessity of establishing a new undertaking, the report, from which we abstract, considers the agency by which this might be carried into effect, as follows:—

Broadly speaking, there are four different agencies by which the new undertaking might be established:—

(*a*) A combination of all the companies and local authorities in Greater London.
(*b*) A new company, formed either by the existing companies, or independently.
(*c*) A new public authority representing the County, and, possibly, certain districts outside, acting alone.
(*d*) A new public authority, of this nature, acting in co-operation with private enterprise.

(*a*) This method may be briefly dismissed. At the present time there is not sufficient cohesion among either the companies themselves or the borough councils, and still less among all the authorities in Greater London, to form even the nucleus of a central body.

(*b*) If private enterprise be the agency decided upon, a company formed under the auspices of the existing undertakings would appear more likely to succeed, and there is at present a proposal for bringing these companies together, though at present no agreement has been reached.

Before considering the other aspects of any scheme of this kind it seems to us essential that the council should satisfy itself upon certain important points, and especially:—

(1) The existence of sufficient unanimity between the various interests and sufficient driving force and financial support to carry it through energetically on the best and broadest lines.
(2) The provision for including the borough council undertakings and the important undertakings outside the county, which together supply over one-half of the total output in Greater London.

It is in these areas that power supply is growing and likely to grow more rapidly than in the London companies' areas where the revenue from lighting still predominates, and the combination of the lighting and power loads is essential to the best results and a satisfactory scheme.

If the existing companies were to form a holding company to erect one or more large stations outside London and to use such stations for the purpose of supplying undertakings both in and around London, provision would have to be made, as far as possible, for the subsequent purchase of these outside stations or as much of them as was necessary. Provision would also have to be made for ensuring that the consumer benefited from the new arrangement.

In fact, the council would also have to arrange:—

(1) Terms for taking over any new station outside the county.
(2) Maximum prices for the retail supply of electricity for power, heating and cooking to the consumer from these stations.
(3) A sliding scale of discounts and dividends paid.
(4) Provision for controlling the raising and expenditure of capital so that these safeguards became effective.

(*b*) (ii) If private enterprise be the agency decided upon and if the existing companies are not able to come to any agreement, or are otherwise unable to put forward a satisfactory proposal, the employment of some independent company, specially promoted for the purpose of establishing the new undertaking, might be considered.

Very similar considerations would apply, as regards the safeguards necessary in the interests of the consumer and public generally, as in the case of a scheme promoted by the existing companies.

(*c*) If a public authority be decided upon as the most suitable agency, the restriction of area from which municipal undertakings have suffered would not apply to a comprehensive scheme covering Greater London.

The advantages of a complete municipal undertaking for London may be stated as follows:—(1) All questions of control or repurchase of the undertaking are avoided. (2) The capital would be raised at the cheapest rate. (3) Any profits that were made would go to the consumer or ratepayer. (4) Certain municipal electric lighting undertakings are to-day showing considerable enterprise in connection with the commercial side of their business and are achieving results which compare very favourably with those of the London electric lighting companies.

The disadvantages of such a scheme may be stated as follows:—(1) Compulsory purchase of existing undertakings would probably be necessary, and this would be most expensive. (2) The encouragement or establishment of by-product developments and subsidiary industries in connection with the generation of electricity would be difficult.

(*d*) The alternatives so far considered are company ownership and operation, and municipal ownership and operation, which both have certain drawbacks and risks.

There is a third course, partial or complete municipal ownership with private operation, under strict municipal control, the bulk of the profits going to the public, whether ratepayer or consumer.

Apart from all questions of the relative efficiency of municipal and private management, the merits of such co-operative arrangements, *compared with absolute company ownership*, are that the risk of watered capital with its attendant evils are avoided. The municipality obtains a share in the profits without, or with only small, accompanying risk, and during the concession it is able to exercise closer control over the working in the public interest, and at the termination can assume possession without having to pay for wasted capital, goodwill, or prospective prospects. There is, also, little difficulty of raising capital during this period, nor the same inducement to "starve" maintenance.

As compared with municipal operation, the advantages claimed by its supporters are that commercial considerations are less likely to be violated for political ends, and that continuity of policy is more certain, while in the case of electricity supply there is the all-important advantage of greater elasticity in development, greater ease in negotiating contracts, and greater freedom in replacing antiquated plant.

In view of the marked success of these co-operative arrangements elsewhere, there would appear many advantages and no insuperable difficulty in applying the same principle to the laying down of a system of electricity supply in the London area.

Such an arrangement would involve:—

(*a*) An owning and controlling authority which would supply the bulk of the capital necessary to construct the new works.
(*b*) An operating body which would work the undertaking on behalf of the controlling authority, guarantee the interest on the capital, and gradually unify and ultimately amalgamate existing undertakings as the agent of, and under the control of the owning authority and special statutory regulations with regard to price and dividends, etc.

The operating body would preferably represent the interests of the existing London companies, though not necessarily those interests solely.

The best results would be secured if the constitution of the controlling authority were to some extent based upon the functions which it would be called upon to perform.

We therefore recommend that the London County Council should promote a bill in the next session of Parliament, empowering some central body to set up an undertaking with powers of bulk supply and the means of *gradually* acquiring and amalgamating the different undertakings on *commercial* terms. We consider that in no other way will it be possible for London to obtain the full advantages of cheap electricity, and moreover that such an undertaking if carried out on proper lines might be made self-supporting at a comparatively early stage.

SUMMARY OF CONCLUSIONS.

(1) The concentration of generating plant on sites down the river is the correct policy to begin with, both on technical and commercial grounds, deferring the question of generating part of the energy at the coalfields or elsewhere until both the load and the load factor have grown.

(2) In order to carry out this policy with the minimum waste of capital a high voltage 3-phase primary distributing system at 50 cycles per second should be standardised for London as soon as possible. In this connection a standard primary voltage should be at once adopted for all new high pressure mains.

(3) If electricity is to be supplied for power and general domestic use at the lowest possible price it is also necessary, both for economical and other reasons, that the existing low pressure distribution networks should, as a rule, not be extended but be supplemented by a new 3-phase network.

(4) The most satisfactory and economical method of achieving these results is the establishment of a new undertaking with such powers as will enable it gradually to concentrate production, standardise distribution, and bring about the amalgamation of all the various undertakings.

The latter half of the report consists of lengthy appendices summarising the technical tendencies of production and distribution; the history of electricity supply in London; and the position of electricity supply in the great cities throughout the world.

A considerable amount of data is included, together with curves and maps; one of which shows the authorized supply areas and generating stations in the Greater London area.

From appendix II., we reproduce two tables which indicate the position at the present time. The first table is taken from the Administrative County of London Electricity Supply Returns, 1911-12.

The municipal authorities have apparently repaid

some 20 per cent. of their loans, while the companies appear to have sinking funds of about two millions.

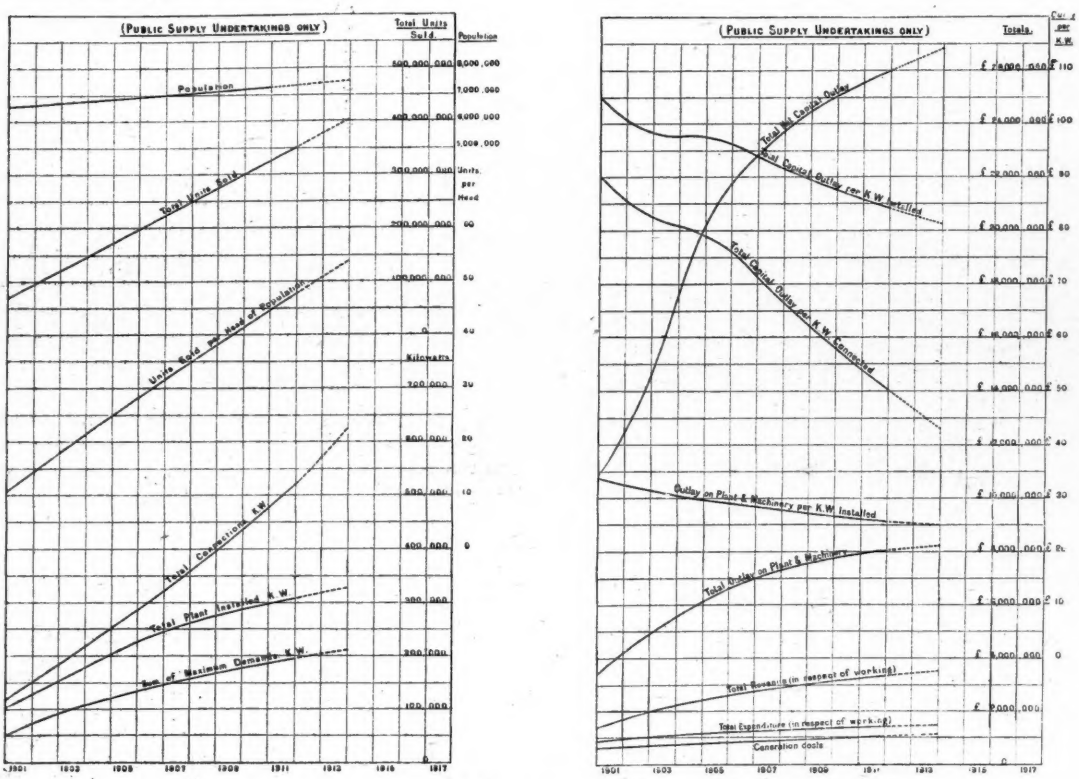
It is considered that the price obtained for most of the existing plant, if sold, would be little more than "scrap" value, and that the value of the sites would be about a million sterling.

Quite a number of successful installations of concrete poles have been made during the past five or six years on this continent and in Europe. Perhaps the largest single installation at present is that of 25,000 poles designed by the writer and installed in connection with the municipal street-lighting and general light and power distribution system of the Toronto Hydro-Electric System in Toronto, Canada, during 1910, 1911 and 1912.

TABLE I.

Statistics of Existing Undertakings in Greater London, 1912.

	County.		Outer London.		
	Local Authorities.	Companies.	Local Authorities.	Companies.	Total.
Total Capital Outlay	£6,581,198	£14,437,257	£3,267,174	£1,711,770	£25,997,399
Total Expenditure on Plant and Machinery	£1,792,700	£4,651,431	£1,115,573	£499,897	£8,059,601
Total KW. connected	137,249	266,510	96,392	23,714	523,865
Total Plant installed KW.	80,603	153,479	53,070	20,186	307,338
Sum of Maximum Demands in KW.	54,474	96,651	31,824	13,772	196,721
Units sold per head of population	21.5	35.5	24.25	11.7	48.5
KW. connected per head of population	.03	.06	.04	.01	.07
Average price obtained, all purposes	2.06d.	2.62d.	2.06d.	1.96d.	2.29d.


(Public Supply Undertakings only)
Total Units Sold.
Population
Units per Head
Kilowatts
Total Connections K.W.
Total Plant Installed K.W.
Sum of Maximum Demands K.W.
(Public Supply Undertakings only)
Totals.
Total Capital Outlay
Total Capital Outlay per K.W. Installed
Total Capital Outlay per K.W. Connected
Outlay on Plant & Machinery per K.W. Installed
Total Outlay on Plant & Machinery
Total Revenue (in respect of working)
Total Expenditure (in respect of working)
Generation costs

Curves showing the Growth of Electricity Supply in Greater London.

TABLE II.

Systems used in 1913.

	Central Area.	Greater London.
Number of generating stations	41	70
Number of Authorities	39	70
Average size of stations	7,646 KW.	5,285 KW.
Average size of units	785 KW.	682 KW.
Number of types or systems of generation	31	49
Number of frequencies	8	10
Number of voltages:—		
Generation	20	32
Distribution	21	24
Number of methods of charging & prices	Over 50	Over 70

REINFORCED-CONCRETE POLES.*

By J. G. JACKSON.

Although reinforced-concrete poles have been the subject of experiment from time to time for a great many years, it is comparatively recently, so far as the writer is aware, that they have been employed or even seriously considered. The high and increasing cost of wooden poles, their comparatively short life, with consequent prospective renewal at greater expense, as well as the public demand for the beautification of city streets, render the consideration of concrete-pole construction desirable for modern overhead systems.

*Reproduced from the *Electrical World*.

The adoption of concrete poles for this installation was due to the necessity of supplying energy to the entire city, comprising over 400 miles of streets, from overhead lines, underground construction being in general too expensive except for the business districts, and a realization that more wooden poles and overhead construction of the usual type, added to streets already occupied by at least two such systems, would be decidedly objectionable.

It was felt that the appearance of an overhead installation could be greatly improved by employing a pole of neat and uniform construction such as could be obtained by the use of concrete. With a suitable lighting system and arrangement of overhead wiring, a pleasing, and, in fact, ornamental, effect can be secured at a cost substantially the same as when wooden poles are employed and with a prospective saving in maintenance expense. This would appear to be of especial interest to the smaller cities and residence districts of large cities, where the demand for underground construction is based mainly on aesthetic considerations but where such construction is not justified by the revenue to be obtained.

In this connection it might be noted that in the recent installation of a street-lighting system with which the writer was concerned, for a city of approximately 10,000 inhabitants, the usual practice of installing a "white way" with underground wiring in the business section and gooseneck fixtures on wooden poles in the residential district was abandoned in favour of the installation of concrete poles throughout. This arrangement resulted in a smaller cost for the entire installation, a decorative system in the residence districts and a "white way" with tungsten clusters carried by heavy cast-iron brackets of ornamental design mounted on the faces of the concrete poles. This, in the writer's opinion, was not lessened in effectiveness by the small number of wires overhead. The concrete poles also served to carry the trolley span

wires where necessary, so that, as in the case of steel trolley poles similarly employed, a minimum of street obstruction resulted.

In the design and construction of the poles employed in the installations referred to an effort was made to eliminate unnecessary details and to render the manufacture as simple as possible in order that poles might be turned out rapidly and at low cost. A pole of solid square cross-section with bevelled edges was adopted. The square section not only made possible a simple form of mould, but, as the strains to which a pole is subjected are ordinarily either normal to or in the direction of the line, this is obviously the most efficient arrangement of the material, especially with the longitudinal reinforcement grouped at four corners, as 50 per cent. of these members are then equally effective in tension in any direction normal to a face of the pole. As the majority of the Toronto poles were intended to carry an ornamental lighting bracket and tungsten lamp, they were provided with a ½-in. iron pipe cast in the pole with lower outlet at the lamp and upper outlet under the line wires.

The earlier poles of the Toronto installation were provided with three galvanized-steel cross-arms cast in the pole and having a hole at each end for a steel core pin. This arrangement of cross-arms was not found sufficiently flexible in obtaining clearances of the lines and was later discarded.

Extra reinforcement consisting of additional bars extending part way up the pole was provided where poles were expected to be subjected to considerable strain. The cross-sections of the poles were determined with regard to the resulting appearance as well as from considerations of strength and cost. As all of these poles were intended for use on city streets, wind stresses could be considered to be a minimum owing to the sheltered location. With the exception of poles on curved streets, the lateral stresses result mainly from service lines to buildings. It is probable that the greatest strain that the majority of these poles would be subjected to was that due to handling in transportation and erection. The reinforcement provided, giving an ultimate strength as measured by the horizontal pull applied at a point 2 ft. from the top ranging from approximately 500 lb. in the 24-ft. poles to 800 lb. in the larger sizes, with extra reinforcement as stated, has been found to be sufficient for the conditions obtaining in Toronto.

Poles at ends of lines or at corners were ordinarily well guyed. Insufficient guying at occasional points, however, resulted in considerable deflections of the poles concerned, with consequent easing up of strains; but in comparatively few cases did breakage of poles result.

A number of poles 24 ft. long with 7-in. by 7-in. base and 4-in. by 4-in. top provided with four ½-in. plain square reinforcing bars were experimented with when determining the

Fig. 1.—A Two-Weeks' Run in Pole Yard, 112 Poles per Day being turned out.

Holes were provided through the pole with a slot on either face so that brackets of any desired length could be bolted to the pole.

The concrete poles employed in this installation ranged from 24 ft. to 35 ft. in length, the majority being 24 ft. long. Standard poles were made with 8-in. by 8-in. base and 5-in. by

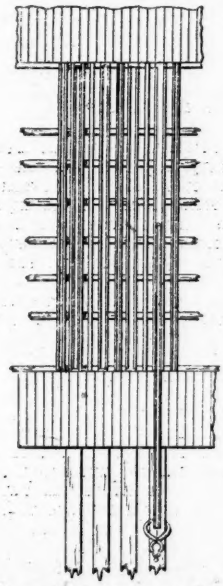


Fig. 2.—Method of Handling and Supporting Poles.

5-in. top for 24-ft. poles, with 9-in. by 9-in. base and 6-in. by 6-in. top for 30-ft. poles, and with 10-in. by 10-in. base and 6½-in. by 6½-in. top for 35-ft. poles. The longitudinal reinforcement consisted of four deformed or square twisted steel bars of high elastic limit set at the corners of the pole and ½-in. from the surface. Three-eighth-inch bars were used in the 24-ft. poles and ½-in. bars in the longer poles.

sizes of the poles to be employed. These poles were found, at thirty days or thereabouts, to be incapable of withstanding the handling and transportation. It is of interest to note that in tests made on poles thirty days old with plain square-bar reinforcement failure resulted from slipping of the reinforcement in the case of ⅜-in. and ½-in. bars. One-quarter-inch square bars broke without appreciable slipping.

The plan employed in the manufacture of these poles consisted in the main of parallel horizontal forms arranged in rows with a runway at one end of the forms for the delivery of concrete, together with concrete mixer and special wagons

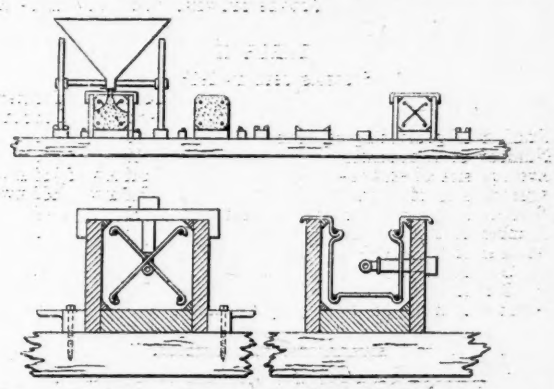


Fig. 3.—Method of Pouring Concrete and Reinforcing.

for placing the concrete in the poles. All forms were constructed of finished Southern pine as more satisfactory results were obtained with this wood than with the less dense and resinous Northern variety. Bases of forms were spaced 2 ft. apart with wooden rails between, one pair of sides being provided for each three bases. A very wet mixture of concrete in the proportions of one part cement to two parts of sharp sand and four parts of crushed limestone of less than ½-in. size was used. The quality of sand used was found to have an appreciable effect on the characteristics of the pole, a sharp sand, as would be expected, tending to produce the more

elastic concrete. Gravel instead of crushed stones was found to give satisfactory results.

A number of mixtures less rich in cement were tried but were found to give a pole somewhat inferior in strength at ages up to thirty days covered by the period of test. The surface, also, was not so good as with the richer mixture. The 1:2:4 mixture employed gave an excess of cement and sand beyond that required to fill the voids in the stone. The method of placing the liquid concrete by pouring from a spout in the

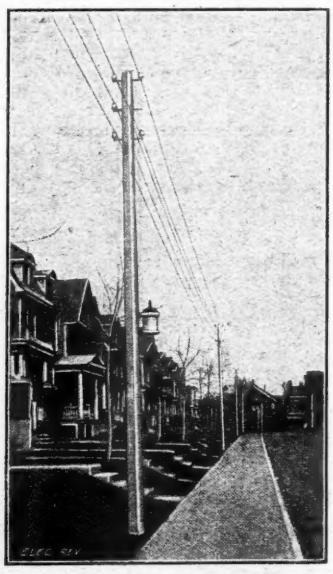


Fig. 4.—Concrete Pole in Residential Section of Toronto, Canada.

bottom of the concrete wagon resulted in the almost complete elimination of air bubbles without special spading or working of the concrete for this purpose after placing in the forms. A small amount of troweling was necessary for the finishing of the upper surface, however. The poles made in this way, when set, presented smooth white cement surfaces showing the grain of the wood on three faces. The hand-finished upper surface was dressed by means of carborundum bricks after removal from the form.

In casting the poles sides were set up and forms poured on every third base during the first day. On the following day the side walls were removed from the first poles and advanced to the second base, and the operation was repeated. On the fourth day the first poles cast were removed from the forms and the cycle of operations was started again. The removal of poles from the forms was accomplished by sliding the pole endwise from the form in stages a distance slightly greater than its length every third day, until sufficiently set for handling.

In the first stage, in order to prevent overstraining of the green poles, an extension of the base consisting of a 2-in. plank slightly wider than and equal in length to the pole was provided. The withdrawal was accomplished by gripping the base of the pole by means of a particularly robust pair of ice tongs made for the purpose, the tractive effort being supplied by a horse attached to a rope on the tongs. Poles were commonly loaded on the outgoing wagons, or piled for storage after the third stage, at approximately ten days after casting.

Vertical reinforcement was placed by laying it in the form on wire hangers suitably spaced and with open hooked portions to carry the reinforcing bars. The lateral reinforcement intended to take up the vertical shear and to prevent failure by buckling consisted of a series of short bars with hooked ends dropped diagonally across the longitudinal members at intervals and for a distance above and below the ground line proportioned to the strain to be provided for. No effort was made to bind the longitudinal reinforcement in a cage by means of the suspension wires or together by means of the cross-reinforcing bars except by hooking together as noted and depending on the setting of the concrete to complete the bond and lock the reinforcement in place.

This method of reinforcement resulted in a minimum cost both for labour and for material. Repeated inspection of poles cast in this way and afterwards broken on test or otherwise proved the method of setting the reinforcement to be sufficiently accurate and the lateral reinforcement to be capable of developing the full strength of the longitudinal steel. It is ordinarily desirable, however, that the lateral reinforcement be such that the pole will fail by crushing of the concrete rather than by breaking of the bars in tension, as in the former case a very considerable force will yet be required to bring the pole to the ground, which would seem to be an advantage in view of the weight of the pole, although the wiring carried would ordinarily prevent the falling of an overstrained pole.

In the manufacture of the Toronto poles three yards were employed during a part of the time, turning out approximately 250 poles per day. Two of these yards were adjacent and employed the same men and equipment, giving an output of 150 poles per day practically at one point. The third yard was located several miles distant in order to shorten the haul for the finished poles to the points of erection. One of the yards with forms for more than 100 poles per day was operated for three successive years and was still in fairly serviceable condition at the end of that time, notwithstanding the exposure of a part of the forms to the weather during two winters.

While the majority of these poles were cast out of doors, about 2,000 were made in a large building during the winter of 1910-11. The labour cost under these conditions was approximately double that found necessary with unrestricted space.

Delivery of poles to erection gangs was carried out by means of ordinary wagons upon which oak frames were set to provide several points of support for the poles—a load consisting of six 24-ft. poles weighing 1,100 lb. and four 30-ft. poles weighing approximately 1,600 lb. Poles were lifted on to the wagons by a loading gang without special equipment and were lowered to the ground on skids.

Ordinary labour was employed in the erection under the direction of line foremen. While three poles erected per day per man was accomplished under favourable circumstances, the average was slightly less than this. Raising pikes with a forked end were used, and poles were lifted and dropped into the holes in the same manner and with the same care as in the case of wooden poles. Twenty-four-foot poles were set 4 ft. in the ground and 30-ft. poles 5 ft. The holes were refilled with the excavated earth, no concrete bases being employed. The small sizes of the bases as compared with wooden poles resulted in a smaller cost for digging holes as a minimum diameter was excavated. While the cartage of concrete poles was comparatively expensive as a result of the weight, the cost of handling and erection was approximately the same as for wooden poles, with a possible advantage in this instance for the concrete pole as a result of the larger number erected and the fact that ordinary labour was employed for this purpose.

Notwithstanding the fact that no special precautions other than ordinary care were taken in handling the poles, the total breakage on approximately 25,000 over a period of about three years covering manufacture, erection and operation was less than 2 per cent. Failure while in service during this period was a small fraction of 1 per cent. per year and resulted mainly from collisions with heavy vehicles and obvious overstraining. While several thousand of these poles have been in service during three winters, carrying from three to six lines ranging from No. 6 to No. 2 and larger, in addition to frequent services to buildings, they appear, except in a number of cases where overstraining is apparent, to be in as good condition as when erected, and inspection of the concrete indicates the improvement which would be expected with age. With the exception of a number of poles which were frozen before the setting of the concrete, no deterioration of the concrete appears to have developed, and examination of the reinforcement of poles broken gives evidence of the preservation of the steel.

Cost of Street-Lighting Poles designed to carry six wires and ornamental tungsten-lamp bracket with conduit connection.

24-ft. Pole, 8-in. by 8-in. Base, 5-in. by 5-in. Top; Volume of Concrete, 7 cu. ft.	
Cement, at 40 cents per bag	$0.700
Stone, at $1.33 per ton	0.400
Sand, at $1.15 per yd.	0.145
⅜-in. steel reinforcing bars, at $1.95	0.889
Suspensions for reinforcing bars	0.056
Lateral reinforcing bars	0.100
½-in. pipe and fittings	0.268
Three galvanized-steel cross arms	0.262
Miscellaneous material	0.050
Depreciation of forms	0.400
Mixer and other plant	0.120
Preparing yard	0.080
Total	$3.47
Labour	1.05
Total labour and material, etc.	$4.52
Adding for engineering supervision, office expenses, 10 per cent.	0.45
Total	$4.97*

30-ft. Pole, 9-in. by 9-in. Base, 5-in. by 5-in. Top; Volume of Concrete, 12 cu. ft.	
Cement	$1.200
Stone	0.710
Sand	0.255
½-in. steel bars, at $1.85	1.893
Suspensions	0.072
Lateral reinforcing bars	0.140
½-in. pipe and fittings	0.430
Galvanized cross-arms	0.262
Miscellaneous	0.060
Forms	0.500
Mixer and other plant	0.120
Yard	0.080
Total	$5.72
Labour	1.31
Total labour and material	$7.03
Plus 10 per cent.	0.70
Total cost	$7.73

*This, of course, includes the iron conduit pipe and galvanized steel cross-arms, so that the cost of a plain 24-ft. pole would be $4.39 and that of a plain 30-ft. pole would be $6.97.

The costs of the concrete poles under the several conditions described were variable, but for a considerable part of the work approximated the figures given in the accompanying table.

It is apparent, of course, that in a comparison of costs of wooden and concrete poles the labour required in preparing the wooden poles and also the painting should be considered as a part of the cost, as the concrete pole is produced as a

finished article. While concrete poles can compete, even in first cost, with wooden poles in many cases, and present decided advantages where appearance is a factor, as in the case of street-lighting systems, it is not, in the writer's opinion, probable that satisfactory or economical results will be had from the occasional manufacture of poles by inexperienced persons.

TELEPHONY IN THE UNITED STATES.

The report of the American Telephone and Telegraph Co., which has just been issued, is practically an epitome of the present position of the telephone industry in the United States. As is well known, this company owns the Bell patents, and controls the greater part of the public telephones in the country.

This report is interesting on account of the separation which was effected during the year from the Western Union Telegraph Co. For three years these companies had worked together, but objection was taken by the Government to the association of interests, and eventually an arrangement was made by which the two companies became distinct and all Western Union shares held by the Telephone Co. were sold.

The extent of the operations of the company can best be understood by an examination of the following figures, which summarise the position in different years:—

	Dec. 31, 1895.	Dec. 31, 1900.	Dec. 31, 1905.	Dec. 31, 1910.	Dec. 31, 1913.
Miles of exchange pole lines	25,330	30,451	67,698	120,175	151,497
Miles of toll pole lines	52,873	101,087	145,535	162,702	171,554
Total miles of pole lines	78,203	131,538	213,233	282,877	323,051
Miles of underground wire	184,515	705,269	2,345,742	5,992,303	8,817,815
Miles of submarine wire	2,028	4,203	9,373	24,636	31,833
Miles of aerial wire	488,872	1,252,329	3,424,803	5,625,273	7,261,363
Total miles of wire	675,415	1,961,801	5,779,918	11,642,212	16,111,011
Comprising toll wire	215,687	607,599	1,265,236	1,963,994	2,333,541
Comprising exchange wire	459,728	1,354,202	4,514,682	9,678,218	13,777,470
Total	675,415	1,961,801	5,779,918	11,642,212	16,111,011
Total exchange circuits	237,873	508,262	1,135,449	2,082,960	2,812,944
Number of Central Offices	1,613	2,775	4,532	4,933	5,245
Number of Bell stations	281,695	800,880	2,241,367	4,030,668	5,415,209
Number of Bell connected stations*	27,807	55,031	287,348	1,852,051	2,717,808
Total stations	309,502	855,911	2,582,715	5,882,719	8,133,017
Number of employés	14,517	37,067	89,661	120,311	156,928
Number of connecting companies, lines and systems				17,845	25,679
Exchange connections daily	2,351,420	5,668,986	13,543,468	21,681,471	26,431,024
Toll connections daily	51,123	148,528	368,083	602,539	806,137

*Includes private line stations

On January 1st of the present year there was one Bell telephone station to each twelve of the total population of the United States. During recent years the gross and net earnings were:—

	Gross Earnings.	Expenses.	Earnings.
1895 ...	£4,978,500	£3,187,000	£1,791,500
1900 ...	9,545,000	6,303,000	3,242,000
1905 ...	20,060,000	13,620,000	6,440,000
1910 ...	34,080,000	23,585,000	10,492,000
1913 ...	44,351,000	32,275,000	12,076,000

The total assets of the company on the last day of the various years were:—1895, £24,770,000; 1900, £47,376,000; 1905, £93,376,000; 1910, £155,002,000; 1913, £201,640,000.

The report gives a number of details in regard to the working of the telephone which are very interesting. Thus at the beginning of this year there were over 12,000,000 telephone receivers and transmitters owned by the Bell Company. None of these were made before 1902, and the average age of all the instruments in use was under five years.

The company claim to have always been in the front in regard to developments in the art of telephony, and at the present they have working on telephone problems at their headquarters 550 carefully trained engineers and specialists, many of them of the highest training and repute.

Details as to the development of long-distance speaking are given. It is expected that within a comparatively short time it will be possible to speak between the Atlantic and the Pacific, and that all the principal cities in the States will be brought in direct telephonic communication with each other.

The full text is given of the arrangement with the Government whereby the separation from the Western Union Telegraph Co. was effected and undertakings were given to allow interchange service connections between subscribers to the Bell system and to independently owned telephone undertakings.

It is impossible in a short resumé of these figures to give more than a dim outline of the working of this vast corporation. It is evident that if ever the United States Government desire to follow the example of our own and to acquire the systems they will have to pay an immense sum for the undertaking, and it would seem from the arguments used that they would have to provide a more continuous policy of working to ensure success than is usual in other branches of State-operated undertakings.

EXPERIMENTS ON AIR-BLAST COOLING OF TRANSFORMERS.

By F. J. TEAGO, A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers *at Manchester, March 24th*, 1914.

Experiments were made on one of a pair of single-phase transformers of the core type in order that accurate information might be obtained as to the relation between the "heat rating" and the quantity and condition of the air. The transformer had a rectangular core with one ventilating duct, and was designed for an output of 12 k.v.a., $\cos\phi = 0.8$, 200 volts (ratio 1 : 1), 50 cycles; the net weight of iron was 82 lb., and net weight of copper, 48 lb. The estimated amount of air for mean coil rise of 50°C., with inlet air at 15°—20° C., equals 5 cub. ft. per sec.

Fig. 1 shows the arrangement of the air-blast plant. The

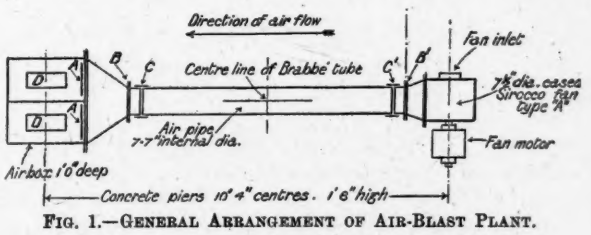

Direction of air flow
Fan inlet
Centre line of Brabbé tube
7½ dia. cased Sirocco fan type A
Air pipe 7·7 internal dia.
Fan motor
Air box 1'0" deep
Concrete piers 11' 4" centres. 1' 6" high

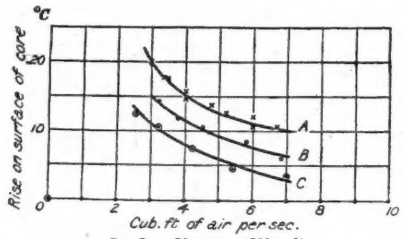
Fig. 1.—General Arrangement of Air-Blast Plant.

air enters at the fan inlet, passing through baffles in the air pipe into the air box, which is divided into two sections, the shutters A controlling the air inlet to the transformers through the openings D. The air baffles, consisting of perforated metal and wire gauze, are placed at each end of the air pipe in the joints B and B'. The baffles at the inlet end of the air pipe are two sheets of perforated metal having 165 perforations

(each of 0.0024 sq. in. area) per sq. in. At the outlet end of the air pipe the baffle is a sheet of wire gauze having 2,500 meshes per sq. in. In arranging the baffles, the object was to get as large a quantity of air as possible through the pipe with a distribution as nearly uniform as possible. C. and C' are leather joints in the air pipe to prevent the transmission of vibrations which would interfere with the Brabbé tube readings.

Each transformer has a sheet-iron case, connected to an air-shoot which discharges the warm air outside the building. When the pipe is baffled the air flow is very steady, and the baffles tend to distribute the air uniformly over the cross-sectional area of the pipe. Within the limits of the velocities taken, the ratio mean velocity : velocity at centre is constant for the baffled pipe. The mean value of 0.972 was taken as being correct.

The first set of experiments was made in order to find out whether the varying humidity of the air had any effect on its cooling properties. It was not anticipated that the effect, if any, would be great since the specific heat of water vapour is only about 25 per cent. greater, for equal volumes, than that



Load = 80 amps., 200 volts.
Curve A, no spray; Curve B, 436 grammes of water per hour; Curve C, 914 grammes of water per hour.

FIG. 2.—COMPARISON BETWEEN AIR AND "FOGGED" ATMOSPHERE AS COOLING MEDIA. (Top of ventilating duct.)

of air, and the amount of water vapour present, even when the air is saturated, is very small. It was found that in the ordinary way the differences due to humidity were too small to be detected.

The mean temperature rise of the coil was 17 per cent. greater than the surface rise at the lowest point observed, and 10 per cent. at the highest point.

A "fogged" atmosphere has been suggested as a cooling medium for electrical machinery on a number of occasions, notably by H. M. Hobart. A number of tests were made with air rendered "fogged" by atomizing water at the inlet to the transformers, and these are compared with similar tests where the air was not "fogged."

In these experiments on the average the cooling effect of the water equals 300 and 600 watts respectively, and the heating effect of the losses equals 900 watts. One might therefore expect the temperature rise to decrease by 33 per cent. in one case, and 66 per cent. in the other. Fig. 2 shows a decrease approximately equal to that anticipated. These results justify the serious consideration of a "fogged" atmosphere as a cooling medium for electrical machinery, especially where the electrical pressure is only moderately high. In the ideal case the air would be thoroughly "fogged" so as to obtain a homogeneous mixture, the amount of water used being no greater than was necessary to ensure that the water particles were not deposited on the coils, etc., as the cooling mixture passed through. The atomizer used in these experiments does not completely fulfil these conditions.

Plant is now manufactured capable of producing very large quantities of "fogged" air eminently suitable for cooling

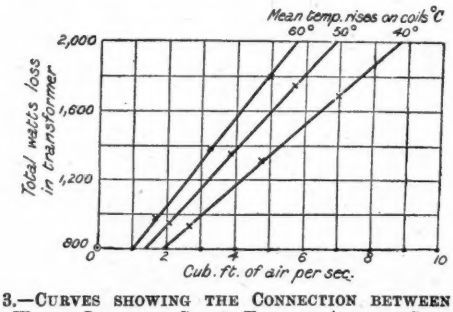


FIG. 3.—CURVES SHOWING THE CONNECTION BETWEEN TOTAL WATTS LOSS AND CUBIC FEET OF AIR PER SECOND FOR VARIOUS MEAN TEMPERATURE RISES ON COILS.

purposes. In one type of plant the air is washed free from dust particles and cooled, and delivered with an amount of free water in suspension which varies from zero to about two or three per cent. of the total volume of the mixture according to the design. The cooling efficiency with plant of this description ought to be fairly high.

As regards the insulation resistance, in these experiments no injury was done to the insulation by the water. The insulation resistance was low immediately after a test, but this was due to the fact that moisture condensed on the bare ends of the windings. When these were dried, the insulation resistance was normal, namely, 10 megohms.

The next set of experiments was conducted with the object of finding the way in which the output of the transformer varied with the number of cubic feet of air supplied per second, the basis being a mean temperature rise of the coils of 50° C.

From the results the following figures are obtained, and have been plotted in fig. 3:—

Mean temp. rise of coils.	60 amperes.		73 amperes.		84 amperes.	
	Cb. ft. of air per sec.	Total watts loss.	Cb. ft. of air per sec.	Total watts loss.	Cb. ft. of air per sec.	Total watts loss.
40° C.	2·7	928	4·75	1,306	7	1,683
50° C.	2·1	955	3·9	1,348	5·7	1,738
60° C.	1·7	981	3·30	1,385	5	1,789

These figures suggest that for any particular value of the total watts loss—

cub. ft. of air per sec. × mean rise of temperature of coil = constant (K).

This should prove of value to the designer, since all the values of K can be determined, for any one type of construction, from the product (cub. ft. of air per sec. × mean rise of temperature of coil) at two different values of the watts loss, since the relation is practically a straight line (see fig. 4).

By extrapolating these curves it is found that for a load of 8 k.v.a. no air at all is required, and for 20 k.v.a. 9 cub. ft. of air per sec. is required.

In connection with these experiments the following general statements may be made:—

1. The temperature rise of the transformer is independent of the temperature of the inlet air within ordinary limits, pro-

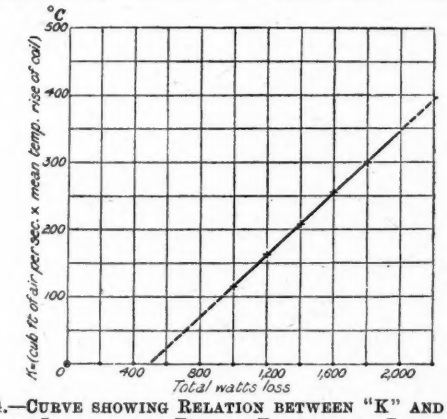


FIG. 4.—CURVE SHOWING RELATION BETWEEN "K" AND TOTAL WATTS LOST FOR THE TYPE OF TRANSFORMER DESCRIBED.

vided that the surfaces to which the heat is radiated, that is the walls, etc., of the room, are at the air temperature.

2. Variations in the barometric pressure only affect the temperature rise to a small extent, and the correction is negligible for the small variations in the barometric pressure from day to day.

3. The humidity of the air, up to the point of saturation, has no appreciable effect on the temperature rise.

DISCUSSION.

Mr. J. FRITH said that although air-cooled transformers were rather a thing of the past, a great deal of the information in the paper could be used for air cooling of other electrical apparatus. Commutation no longer limited the output of machines, the limit being now temperature rise. There was still a field for the suggestion of compressing the air outside and letting it expand into the case of the machine. This seemed to get the heat out in more manageable form.

Mr. W. CRAMP wrote that the co-efficient ratio of mean velocity to velocity at centre which the author gave as something over 0.9 was quite in agreement with his own experience, although some authorities placed their co-efficient between 0.6 and 0.9.

Mr. H. MAWSON gave test results of a 1.5 H.P. Sirocco fan running at 900 r.p.m. and discharging into a square duct 10in. by 10in. A Pitot tube similar to the author's Brabbé tube was employed, the manometer being of the sloping tube pattern using paraffin of density .823, which gave very satisfactory results with the 1/16in. bore. Arrangements had to be made to place the tube in any position over a half section of the duct. It was customary in fan experiments to separate the energy of discharge into two portions, one utilised in overcoming the static pressure head and the other used in creating

velocity head, and it was for this reason that the mean velocity head was calculated. In order to get smooth curves baffles had to be applied, having 100 meshes per inch. With the fan running at the lower speeds, very smooth curves were obtained and the mean velocity of the flow was 0.92 of the velocity as measured at the centre of the duct. The mean velocity head was 0.855 of the velocity head at the centre. At the higher fan speeds, even with baffles, smooth curves could not be obtained. Fan testing did not permit of excessive baffling, and a good method was to discharge the air into a large box where its velocity would be destroyed and then allow it to flow through an orifice when at the same time the difference of pressure head on the two sides could be measured. Provided the cross section of the orifice was less than one-twentieth part of that of the box, consistent results could be obtained.

Mr. C. C. Aitchison said in connection with cooling of generating plant that in a particular case air passed through one cooler and then through a number of ducts to individual machines. The arrangement worked all right while all machines were in operation, but if one or two machines were not in service the distribution of air was not correct, and in order to overcome the trouble it had been necessary to carry division plates not only through the eliminator section, but right through the whole filter.

Dr. Worrall thought "fogged" air had a future, especially in the case of turbo-generators. There should be no loose moisture about, and the question of condensation would have to be studied. Although it was generally considered that water vapour was detrimental to windings, it was not the water so much as the chemical fumes dissolved in it. It was of the utmost importance to have air perfectly clean, as with forced ventilation the ducts were soon choked up if the air was dirty.

Mr. K. Faye-Hansen said on checking the ratio connecting centre and mean velocity he found it to be approximately 0.94 and not 0.972, which showed still more clearly the improvement due to the baffles. He did not consider that "fogging" increased cooling sufficiently to warrant its use on high-voltage machines, as an increased rating of only about 10 per cent. was obtainable, which could easily be achieved by forcing a little more air through the machine. There was also the difference in cost to be considered, and the fact that free moisture would give trouble in the windings.

Mr. A. E. McKenzie spoke strongly in favour of wet air filters, and considered that one large filter would supply a number of machines successfully, provided that portions of the filter were cut in and out with the machines in order to maintain a constant flow of air through the baffle plates. Wet air filters and dry air filters cost about the same initially, but the upkeep of the former was much the smaller.

Mr. W. A. Bristow asked for more definite information regarding the effect of initial temperature on temperature rise.

Mr. J. L. Thompson considered that a shell type transformer should have been chosen for the tests.

The Author, in reply, said the experiments were made in order to obtain more definite information concerning the relation between quantity of air supplied and consequent temperature rise, and to bring forward the value of "fogged" air as a cooling medium, rather than to justify the air cooling of transformers. No matter how carefully the atomising was carried out initially, there was always a tendency for the water particles to coalesce and be almost immediately deposited if too much water was present in a given quantity of air. The latent heat of vaporisation of the water was much more important than the specific heat of either water vapour or air, and it was doubtful if a refrigerator could compete successfully with plant designed to fog the air on the point of cost for equal effect. The author advocated the wet filter, particularly the type employed by Mr. Christie at Brighton. If "fogging" was carried out correctly no deposit of moisture would be produced, because as soon as the particles of water touched the windings they would be evaporated. The danger of moisture lay almost wholly in the impurities, and in "fogging" air impurities could easily be avoided. Regarding the temperature of the air and water before mixing, since the latent heat of vaporisation of the water was the predominant factor, any exchange of heat could have very little effect on the final result, and the whole of the cooling could be attributed to the presence of water particles. That the cooling effect of air was proportional to its velocity within wide limits was due to the air being churned, although the law held good when air was passed through narrow ducts without becoming turbulent. In view of the present-day practice relating to the computation of the amount of air required for cooling electrical machinery it was correct to assume the product cub. ft. air per sec. × mean temp. rise = constant provided the loss remained constant. It was not correct at any rate for transformers to write:—cub. ft. air per sec. × mean temp. rise ÷ kw. loss = constant. In the experiment it was only possible to observe the effect of variation of inlet air temperature on the final temperature rise within the limits 14° C. to 20° C., and over this range the correction was certainly negligible.

Italy.—The Walsall Electrical Co., Ltd., have been placed upon the Italian Admiralty list for the supply of circuit breakers, switches, ammeters, voltmeters and dynamo brushes.

A NEW MAGNIFYING RELAY.*

The long outstanding problem of the telephone relay, or device for reproducing and magnifying small rapidly-varying currents, is one still calling for a complete solution. Amongst the suggestions which have come up from time to time has been one for the employment of the variable conducting properties of the stream of electrons in a cathode tube for the purpose, but hitherto this has been without much success.

Messrs. R. von Lieben and E. Reisz have now, however, devised an arrangement on these lines which appears to overcome most of the difficulties, and which is being put on the market by the Allgemeine Elektrizitäts Gesellschaft, the Siemens & Halske A.G., the Felten and Guilleaume A.G. and the Gesellschaft für Drahtlose Telegraphie acting in conjunction.

The principle on which the new relay depends is the rapid variation of discharge current with voltage between the electrodes in an exhausted tube at and about a particular value of the current (the saturation current).

In order to utilise this effect to the best advantage, a third electrode of perforated metal is introduced in the tube between the main cathode and anode to act as an auxiliary anode.

Thus, in fig. 1, K is the main cathode, A the main anode, and H the auxiliary anode. When a discharge takes place between A and K, the stream of current-carrying electrons passes at high speed from the cathode towards the anode A, and some of them pass through the openings in H, while a large part of them will come into

Fig. 1.

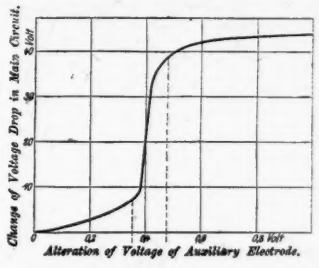


Fig. 2.

contact with H, and be absorbed by it. This absorption raises the (negative) potential of H, and thus gradually reduces the fall of potential between K and H, and so reduces the speed of the main stream of electrons below K and H, and of those few electrons which pass through the gaps to the anode.

This reduced speed further reduces the ionisation produced between the auxiliary electrode and the anode. Both these effects of (1) reduced speed of the original electrons, and (2) reduced ionising power, acting together lead to a marked increase in effective resistance of the tube between the main cathode and anode and a corresponding fall in current.

The very marked effect of a small difference in the voltage applied to the auxiliary electrode on the voltage drop between the main electrodes is shown by the curve of fig. 2. It is this sensitiveness which is made use of in constructing the new relay. The voltage variations of the primary circuit which are to be magnified are superposed on the voltage between the auxiliary electrode and the cathode, either directly or inductively, the initial voltage

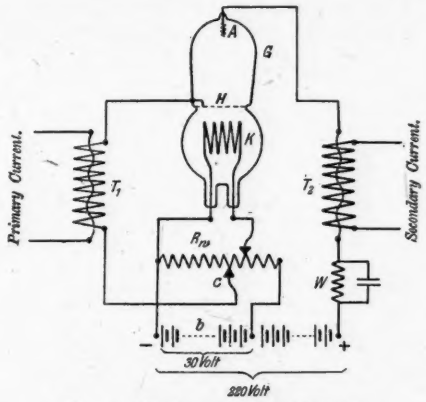


Fig. 3.—Connections of Relay.

having first been adjusted to the most sensitive conditions, as shown at *c*, fig. 2. The arrangement suggested is shown in fig. 3. G is the partially-exhausted glass vessel containing the three electrodes (cathode K, anode A and auxiliary electrode H). The cathode K is of a type due to Wehnelt, and consists of a platinum strip coated thinly with barium oxide and calcium oxide and wound on a glass support. This strip is maintained at a bright red heat (about 1,000° C.) by the battery *b* of 30 volts.

* From a paper read before the Elektrotechnischer Verein by E. Reisz. *E.T.Z.*, November 27th, 1913.

The adjustment of the potential difference between the cathode K and the auxiliary electrode H is effected by the slider C, moving over the resistance R_w connected across the battery *b*. The primary currents act inductively on this voltage by means of the transformer T_1. The secondary (magnified) currents are obtained from the secondary of the second transformer T_2. This transformer is not essential, but is a convenient means of keeping the main supply voltage of 200 to 250 volts away from the apparatus in the secondary circuit. The resistance W is for the purpose of limiting the current through the tube to a reasonable value. In order to avoid weakening the alternating currents, however, this resistance is bridged by a suitable condenser.

With such an arrangement the main current variations of the anode are indicated visually by the fluctuations of the height of the dark space above the auxiliary electrode, so that if, for instance, the primary of T_1 is connected to a battery and microphone, and the latter is spoken into, the glow discharge about the anode can be seen expanding and contracting in unison with the speech waves.

The pressure of the gas in the tube has an important effect on the behaviour of the relay, and experiment showed that if mercury vapour was present, not only was the constancy of the pressure greater, but the discharge voltage was also considerably reduced. The effect is not quite the same as in the ordinary mercury vapour lamp, for in the latter the current carriers are the mercury vapour ions produced by using a high current density at the cathode, whilst in the relay the mercury vapour is independently ionised by the action of the oxide-coated cathode, and then carries the greater part of the current. It is found that under these conditions very little occlusion of the gas molecules in the tube occurs during action, and an average working life of 1,000 hours has thus been reached, whilst some tubes have shown as much as a 3,600-hour life.

If mercury vapour and a little liquid mercury are used in the tube the pressure inside is fairly constant, but is still affected by room temperature variations, and it has been found better to replace the pure liquid mercury by an amalgam.

The actual type of construction adopted by the A.E.G. is shown in fig. 4; *g* is the glass vessel, A is the anode composed of a spiral of 2 mm. diam. aluminium wire, H is the auxiliary electrode

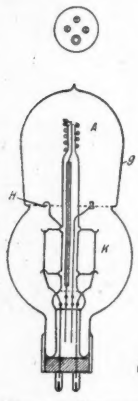


FIG. 4.—SECTION OF RELAY.

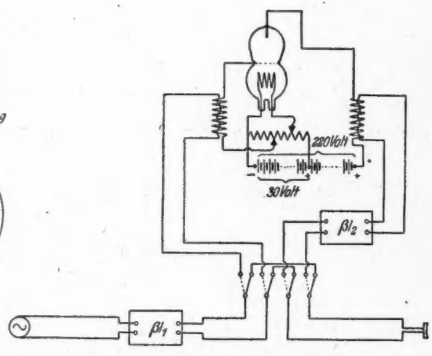


FIG. 5.—TEST CONNECTIONS.

of sheet aluminium—perforated all over its surface with 3·5 mm. diam. openings. The cathode K consists of a platinum strip about 1 metre long, 1 mm. wide, and ·02 mm. thick, coated thinly with a mixture of calcium oxide and barium oxide. The connections to the supply are made by a plug contact at the base of the lamp, which can only be inserted the right way round. Two direct-current supplies are necessary—one, of about 30 volts, which must be quite steady if the lamp is to operate reliably, and cannot, therefore, be taken from a dynamo, as the commutation irregularities are too great; and the other of 220 volts, which can be taken from an ordinary dynamo circuit provided that irregularities are smoothed out by the insertion of choking coils and condensers.

The lamp is mounted on the top of a case containing all the necessary regulating resistances, &c.

In order to test the magnifying powers of this relay, the connections shown in fig. 5 were adopted. A high-frequency A.C. supply is connected through suitable resistances, βl_1 to a sensitive telephone, when the change-over switch is in the full line position.

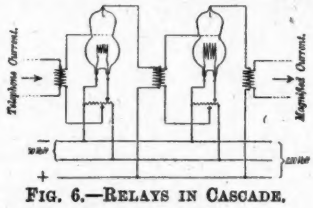
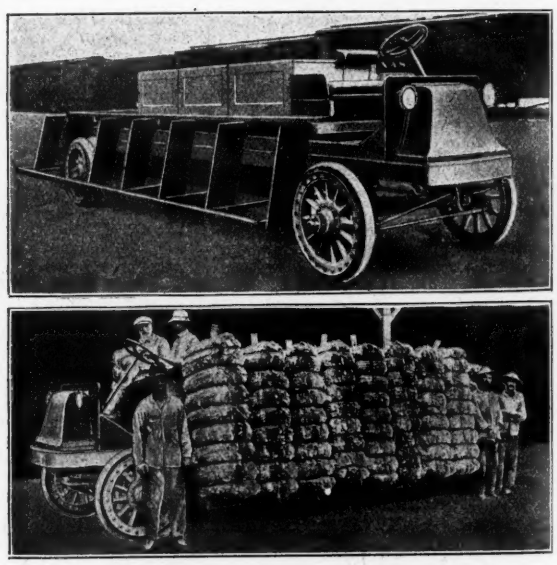


FIG. 6.—RELAYS IN CASCADE.

When this switch is moved into the dotted position, the relay and an additional resistance combination βl_2 are inserted between βl_1 and the telephone. The resistance combinations βl_1 and βl_2 were made up of elements, each of which gives a damping factor of ·1, *i.e.*, the ratio of the current amplitudes before and after such an element is $1/\epsilon^{-1}$. In making a test, the value of βl_2 is adjusted until the sound in the telephone is equal in both positions of the switch, then the value of the damping coefficient of βl_2 is a measure of the magnifying power of the relay. The value of the above ratio so obtained was $1/\epsilon^{-3\cdot5}$ for frequencies between 2,000 and 8,000, and for all values of the initial damping coefficient βl_1, even up to $\beta l_1 = 10$. This value $1/\epsilon^{-3\cdot5}$ is equivalent to a current amplitude magnification of 33. Further magnification can, of course, be obtained by using two or more relays in "cascade," as shown in fig. 6. It is estimated that with four relays arranged in this way a magnification of 20,000 could be obtained without appreciable distortion.

The absence of inertia in the relay renders it practically instantaneous in responding to current variations, and will probably enable it to be profitably applied in high-frequency wireless work as well as in ordinary telegraph and telephone work and in the testing laboratory.

Electric Truck Displaces Mules.—Carrying a load of 25 bales of cotton, a 6-ton electric truck in Galveston is doing the work formerly done by six mules, and is not only more economical, but speedier, in its operation. The novel feature of the device is a so-called cotton saddle which hangs outside the rear wheels and permits easy loading, as it has only a few inches clearance. This makes it possible to load it to capacity with very little lifting of the heavy bales. The truck was built by the General Motors Co., and the saddle is the design of Mr. John Mitchell,



BATTERY VEHICLE FOR CARRYING COTTON BALES, IN USE IN U.S.A.

superintendent of the Moody Compress, who has studied for years the problem of cheapening transportation of the bulky product. The machine has an average speed of 8 miles an hour, loaded, and makes six round trips between the compress and the docks, or about 30 miles a day. Plans for using ten such trucks during the year are under way, and it is probable that the new type will displace the ones in use heretofore.

Electricity Supply Rifle League.—The following are the results of the matches arranged for March:—Brimsdown (Grant, 93), 533, *v.* Hackney (Hilling, 94), 536; Brompton (Mugford), 98, 564, *v.* St. James's (Roberts, 93), 542; Brompton (Physick, 98), 579, *v.* Westminster (Horley, 99), 558; Central (Cope, 97), 560, *v.* Ilford (Haeger, 96), 555; Central (Harvey, 99), 581 *v.* St. James' (Hocking, 98), 560; Ilford (Haeger, 100, H.P.S.), 568, *v.* Poplar (Randall, 92), 521; Poplar (Randall, 92), 523 *v.* Shoreditch (Weekes, Thomas, Harrison, 97), 574. The following are the positions to date:—

	Shot.	Matches. Won.	Lost.	Pnts.	Scores.	Average.
Brompton ...	2	2	0	4	1,143	571·5
Central ...	2	2	0	4	1,141	570·5
Shoreditch ...	1	1	0	2	574	574
Ilford... ...	2	1	1	2	1,123	561·5
Hackney ...	1	1	0	2	536	536
Westminster	1	0	1	0	558	558
St. James's ...	2	0	2	0	1,102	551
Brimsdown ...	1	0	1	0	533	533
Poplar ...	2	0	2	0	1,044	522
City Co. ...	0	0	0	0		
County Co. ...	0	0	0	0		

ELECTRICAL TRADES BENEVOLENT INSTITUTION.

THE following are the further lists of contributions mentioned in our last issue:—

OTHER CONTRIBUTIONS IN CONNECTION WITH THE FESTIVAL.

	£	s.	d.
Abel, R. P.	0	5	0
Adnil Electric Co.	2	2	0
A. H.	0	5	0
Allen, Gerbert	1	1	0
Andrews, F. E.	1	1	0
Andrews, O. M.	0	10	6
Annacker, J. P.	0	10	6
Anonymous	5	5	0
A. P. B.	0	5	0
Ardis, R.	0	10	0
Armorduct Mfg. Co.	3	3	0
Ashwell & Nesbit	0	10	0
Ashworth, H.	0	10	6
Baker, G. T.	1	1	0
Baldwin, J. H.	0	10	0
Barkham, C.	0	10	6
Barnard, —	0	10	6
Barr, Moering & Co.	1	1	0
Barwell, James, Sons and Co.	0	10	6
Bastian, C. O.	1	1	0
Bastian Heating Syndicate	2	2	0
Bastian Meter Co., Ltd.	2	2	0
Baughan & Co.	0	10	6
Beaver, A. G.	1	1	0
Becker, R., & Co.	1	1	0
Belshaw, Thos. O.	2	2	0
Bentley, Geo.	2	2	0
Berliner, M.	1	1	0
Berridge, Geo. & Co.	2	2	0
Bertram, C.	0	10	0
Best & Lloyd, Ltd.	1	1	0
Bevis, H.	2	2	0
Bill, J. C.	0	2	6
Birmingham Light Co.	1	1	0
Bishop, S. & C., & Co.	0	5	0
Blackburn, Starling and Co.	2	2	0
Bond, W. G.	0	10	6
Bottchers Sohne	0	19	0
Boulton, G. & Son	0	10	6
Bowden, J. Horace	1	1	0
Breeden, J., & Co.	1	1	0
Brightwell, R.	0	10	6
Brimsdown Lamp Works	2	2	0
British Oxygen Co.	1	1	0
Broadribb, A. H.	0	10	0
Bruce, J. B., Ltd.	2	2	0
Brundle, F. H.	0	10	6
Buck & Hickman, Ltd.	1	1	0
Burney, Guy	2	2	0
Burt Bros.	1	1	0
Burton, Col. H.	1	1	0
Calvert, E.	0	10	6
Cantie Switch Co.	1	1	0
Carr & Parr	0	10	6
Chamberlen	0	10	6
Chaplin, H., & Co.	0	10	6
Charles & Dible	1	1	0
Child, J. S.	1	1	0
Clark, E. J.	1	15	0
Clifford, C., & Son, Ltd.	1	1	0
Clothier, H. W.	1	1	0
Collings, F. W. A.	0	5	6
Colwal, R. F.	0	5	0
Cook, A. H. J.	0	10	0
Cook, W. W.	1	1	0
Cookson & Co.	1	1	0
Conradty, C.	3	0	0
Cowan, E. W.	1	1	0
Crampton & Sons	0	10	6
Cranmer & Cheshire	1	1	0
Cripps, G. W.	0	10	0
Cryselco, Ltd.	1	1	0
Dade, C. H.	0	10	6
Davidson & Co., Ltd.	1	1	0
Davies, Kent and Stewart	0	10	6
Davy, A.	0	10	6
Devonshire, Jas.	3	3	0
Digby, T. J.	5	5	0
Dow, J. D.	0	10	6
Down, F. J.	1	1	0
Easton, C. J.	1	1	0
Eberstein, J.	1	1	0
Edison & Swan U.E.L. Co.	10	10	0
Edwards & Barnes	1	1	0
"Electrical Review," Proprietors of	10	10	0
Electricitate Gesellschaft Sirius	2	8	6
"Electricity," Proprietors of	1	1	0
Ellice Clarke, E. B. Ellison, G.	2	0	0
Endolithic Mfg. Co.	1	1	0
English Bros., Ltd.	0	10	6
Esson, W. B.	1	1	0
Everett, Edgecumbe and Co.	2	2	0
Evershed & Vignoles, Ltd.	5	5	0
Falk, Max	3	3	0
Falk, Stadelmann and Co.	5	5	0
Ford, C. J.	2	2	0
Forster, J., & Co.	1	1	0
Fox, H. C.	0	10	6
Frankenberg, I., and Sons	1	1	0
F. S. W.	0	2	6
Fuller Elec. and Mfg. Co.	1	1	0
Garbe, Lahmeyer & Co.	2	0	0
Gent & Co.	3	0	0
Gimingham, E.	1	1	0
Glaholm & Robson	0	5	0
Goodyer, T. B.	0	10	6
Graves, T.	1	1	0
Green & Co.	0	10	6
Grey & Marten, Ltd.	0	10	6
Groves, J. & B.	1	1	0
Hamilton, T. S.	1	1	0
Hardy & Padmore	0	10	6
Hart Accumulator Co.	10	10	0
Hartman & Braun	2	0	0
Hatton, R. J.	2	2	0
Hay, G.	1	1	0
Henderson & Walker, Ltd.	0	10	6
Henley's Telegraph Works	25	0	0
Hewetson & Co.	0	10	6
Hill, Fred. A., & Co.	0	10	6
Hill Jones, T.	1	1	0
Hinton & Brockington	0	10	6
Hobbies, Ltd.	1	1	0
Holmes, F. J.	1	1	0
Home & Rowland	1	1	0
Hornsby, Richard, and Sons, Ltd.	1	1	0
Howard, A. H.	1	1	0
Howley, Richard J.	1	1	0
Howse, T., Ltd.	0	5	0
Hudson, Edmunds and Co.	0	7	6
Hunter, C. E.	1	1	0
Hurst, A., & Co.	2	2	0
Ickelheimer, Max	1	1	0
Indestructible Cable Co.	2	2	0
International Trade Exhibitions	5	5	0
Isaacs, Godfrey	21	0	0
Jacoby, A. M.	1	1	0
Jeary, W. C.	1	1	0
Joseph, M.	0	2	6
Joyner, Chas., & Co.	1	1	0
Judd, W.	1	1	0
Kahn, S.	0	10	6
Kiesow & Co.	1	1	0
Kidd, G. W.	1	1	0
Korting & Mathieson	2	0	0
Krausse & Anerbach	1	1	0
Land & Seekabelwerke	1	1	0
Leach, S. G.	1	1	0
Leaf, H. M.	1	1	0
Lee, H.	0	10	6
Leftwich, A.	0	10	6
Locke, Lancaster and Co.	1	1	0
London Elec. Trading Co.	2	2	0
London Electric Firm	1	1	0
London Zinc Mills, Ltd.	0	10	6
Lund, Humphries & Co.	0	10	0
Lynen, R.	2	2	0
MacGregor, G.	0	10	6
Madgen, W. L.	1	1	0
Marchant, H. F.	1	1	0
Mason & Burns	1	1	0
McDougall, J., Ltd.	1	1	0
Miles, J., & Co.	1	1	0
Miskin & Rice	1	1	0
Mitchell, Lucas and Mitchell	1	1	0
Morris, H. N., & Co.	1	1	0
Morrison, Alex.	1	1	0
Morse, S.	1	1	0
Moseley, D., & Sons, Ltd.	2	2	0
Mosers, Ltd.	0	10	0
Moul, H. E.	1	1	0
Murray, E. T. Ruthven	2	2	0
Nauheim, J. J.	5	5	0
Nestler & Co.	1	0	0
Newman, F. N.	0	10	6
Nixon, J., & Sons	0	5	0
Oliver Typewriter Co.	0	10	0
Ollivant, Sir E. C. K.	3	3	0
Owens, T. J.	0	5	0
Packenham, —	0	10	6
Parsons, I. H.	2	0	0
Peckham, G. S.	0	10	6
Pell, F. Bennett	0	10	6
Peyton, & Peyton, Ltd.	2	2	0
Pfeil & Co.	0	10	0
Pilkington Bros., Ltd.	0	10	6
Plummer, J.	0	5	0
Pollard, Wm., & Co.	1	1	0
Pond, E. J.	0	8	6
Poole, R.	0	10	6
Potter, W. J.	2	2	0
Preece, Cardew and Snell	2	2	0
Preece, Llewellyn	2	2	0
Premier Accumulator Co.	0	10	6
Prestige, J. Theo, Jun.	1	1	0
Pritchard, John, and Sons	0	10	6
Quitmann, Carl	1	1	0
Rainsford & Lynes, Ltd.	1	1	0
Rashleigh, Phipps and Co.	1	1	0
Reade & Co., Ltd.	1	1	0
Reader, E., & Sons	1	1	0
Reiss, C.	3	3	0
Reliance Elec. Wire Co.	0	5	0
R. M. S.	0	2	6
Rosling, Percy	10	0	0
Russell, C. Newton	0	10	6
Russell, S. G. Castle	1	1	0
Saltrick, W. R.	2	2	0
Sanderson, C. F.	0	10	6
Sankey, Capt. H. P.R.	2	2	0
Sargent, Miss B. M.	1	1	0
Schmahl, W.	2	2	0
Schmahl, W. (Staff Collections)	0	13	0
Schumann, Miss	0	13	0
Shield, W. S., & Co.	1	1	0
Ship Carbons, Ltd.	1	1	0
Silcock, Charles	1	1	0
Sloan Electrical Co.	2	2	0
Smith, G.	0	10	0
Soames, E. R.	0	10	6
Southgate & Co.	0	10	6
Spagnoletti, James	1	1	0
Spear, F. B.	1	1	0
Spicer & Pegler	1	1	0
Spies Bros. & Co.	1	1	0
Spratt, L. W.	1	1	0
Sterling Telep. and Elec. Company	3	3	0
Stockwell, E. J.	0	10	6
Stone, J., & Co.	5	5	0
Sudicatis, Ludio, and Co.	1	0	0
Sugden & Hextall	1	1	0
Sun Electrical Co.	3	3	0
S. W. A.	0	5	0
Swiss Bankverein	2	2	0
Tapper, Wm. C. P.	1	1	0
Taylor Bros.	0	10	6
Taylor, Geo. E.	5	5	0
Taylor, W. H.	0	10	6
Tegetmeier, C. V.	2	2	0
Textile Machine Co.	5	5	0
T. S.	0	2	6
Thacker, F. C.	0	10	6
Thompson, W. P., and Co.	1	1	0
Thornley, E.	0	5	0
Thurnauer, L.	3	3	0
Thurnauer, L. (collected by)	0	19	6
Tong, G. E.	1	1	0
Turner & Burger	0	10	6
Universal Supply Co.	0	10	6
Unwin Bros., Ltd.	1	1	0
Vandervell, C. A.	1	1	0
Voigt & Haeffner	2	0	0
Von Chauvin, G.	2	2	0
Waddie & Co.	0	10	6
Wall, G. P.	0	10	0
Wallace Bros. & Co.	2	2	0
Walton, W. H.	1	1	0
Ward & Goldstone	3	0	0
Watlington & Co.	0	10	6
Whitehouse, Wm., and Co.	0	10	6
Whittall, W. J., and Son	1	1	0
Wilson, J. G.	0	10	0
Winter, F.	5	0	0
Wolf, A.	1	1	0
Wordingham, C. H.	2	2	0
Worrell & Baynes	1	0	0
Worster-Hounslow Elec. Co.	0	10	6
Wortley, Charles B. Stuart, K.C.M.P. (Rt. Hon.)	5	5	0
Barber-Starkey, W. T. S.	0	10	6
Barton, A.	1	1	0
Beales, Morton	1	1	0
Berry, H.	1	1	0
Bishop, O. H.	1	1	0
Coates, C.	0	10	0
Cooper, R. G.	0	10	0
Dolamore, H. O.	0	2	6
Eck, Justus	25	0	0
Electromotors, Ltd.	2	2	0
Escudier, C. M.	0	10	0
Ferranti, Ltd.	5	5	0
Friedeberg, C. G.	0	2	6
Gillespie, M. M.	1	1	0
Hart, H. M.	0	2	6
Hawes, F. B. O.	1	1	0
Hemsley, E.	0	2	6
Hobbs, W. E.	1	0	0
Hunt, R., & Co.	1	1	0
Icke, J. R.	0	2	6
Kingsbury, J. E.	2	2	0
Kingston, H. W.	0	10	6
Kolle, H. W.	2	2	0
Lawrence, A.	0	10	6
Lemmon, Miss M.	0	10	0
Linolite Co.	1	1	0
Llewellyn, D.	0	10	0
Lundberg, A. P.	20	0	0
Lundberg, P. A.	10	0	0
Lundberg, G. C.	20	0	0
MacCarthy, A. F.	0	10	0
Madgen, W. L.	3	0	0
Moore, F. C.	0	10	0
Moulton, Lord	1	1	0
Murray, J. O'Hara	2	0	0
Nance, Harry	0	10	0
Nash, E. A.	1	1	0
Nierbauer, A. P.	0	2	6
Quance, F. G.	0	10	0
Randall, W. O.	0	2	6
Ratcliffe, G. Fred	1	1	0
Redmayne, L.	0	10	0
Reynolds & Bradwell	2	2	0
Richards, W. L.	0	10	6
Riseley, D. S.	0	10	0
Ritchie, T. E.	0	2	6
Robinson & Hands	1	1	0
Ruberoid Co.	1	0	0
Salomons, Sir David, Bart.	5	5	0
Samuelson, G. B.	2	2	0
Snell, J. F. C.	1	1	0
Sparrow, J. V.	0	10	0
Spencer, J., Ltd.	5	5	0
Stewart, Andrew	1	1	0
Stiller, C. H.	0	2	6
Sutton, Geo.	10	10	0
Thomas, Miss W.	0	10	0
Vaughton, W. C.	0	10	6
Walsh, R. F. V.	0	2	6
Wallis-Jones, Reg. J.	1	1	0
Williams, G. S.	0	10	0
Wilson, J. G.	0	10	0

£148 5 0

	£	s.	d.
Chairman's List	2,463	15	1
Other Contributions connection with the Festival	418	14	0
Contributions received in the course of the year	148	5	0
	£3,030	**14**	**1**

£418 14 0

THE FOLLOWING CONTRIBUTIONS HAVE ALSO BEEN RECEIVED IN THE COURSE OF THIS YEAR.

	£	s.	d.
Anderson, A. Bruce	2	2	0
Anonymous, per S. R. Smith	0	5	6

International Engineering Congress, 1915.—The attention of the engineers of the world is being drawn to the programme of the International Engineering Congress, which is to be held in San Francisco, California, in 1915. At present enrolments and subscriptions have been received from 42 foreign countries, and of the present enrolment, approximately 25 per cent. is from countries other than the United States. In order to facilitate the work of the committee of management, it is extremely desirable that as many as possible who intend to subscribe should do so at an early date. Full information concerning the Congress may be obtained by addressing the committee of management as follows:—International Engineering Congress, 1915, Foxcroft Building, San Francisco, California, U.S.A.

High Temperatures and Electricity.—In a letter addressed to *Nature* of the 23rd ult., Messrs. G. W. C. Kaye and W. F. Higgins give briefly the results of recent experiments at the National Physical Laboratory on the emission of electricity from a number of substances at very high temperatures—between 2,000° C. and 2,500° C. The experiments were carried out in a carbon-tube resistance furnace at atmospheric pressure. Among the substances tried were the alkaline earths and a number of metals. In every instance the temperature was sufficient to vaporise rapidly the substance under test, and under these conditions very large amounts of electricity were emitted. For example, barium oxide emitted negative currents of the order of 4 amperes per sq. cm., while boiling tin gave currents of about 2 amperes per sq. cm. No external potential was applied in any of the experiments.

A Submarine Ship-Cleaner.—A recent issue of the *Shipping World* contains a description of a new apparatus for cleaning ships' hulls, without dry docking, which has been introduced by the Submarine Ship Cleaner Co., Ltd., of Melbourne, and demonstrated in this country.

Briefly, the apparatus consists of a barge equipped with a 28-H.P. petrol-electric set, which supplies power for driving the barge along, also to a winch which raises and lowers the cleaning device slung over the side from the end of a jib, and for operating this apparatus, which is in the form of a brushing gear. The latter consists of a revolving cylindrical brush, 5 ft. long by 1 ft. diameter, and a thrust propeller behind to keep the brush against the ship; between brush and propeller a 10-H.P. submersible-type motor is fitted, operating the former through a worm-geared countershaft and chain gearing, and the latter through concentric reducing gear. The air weight of the submersible gear is 800 lb., but floats are attached which reduce this to 280 lb. The brush is fitted with fibre bristles, 2½ in. long, and in practice a strip of plating 4 ft. wide is cleaned by each lowering and raising operation, which represents some seven hours for cleaning a vessel of 400-500 ft. long and average draught. The work can be carried on by day or night, and while the vessel is coaling, loading, or discharging.

Electricity in Agriculture.—Trials have been made with electrically-driven ploughs in one of the provinces of Aragon, Spain, with such success that, according to *Electron*, a further 1,000 hectares will shortly be submitted to similar treatment.

NEW PATENTS APPLIED FOR. 1914.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

9,213. "Electric cooking-ovens." I. T. NEGUS and L. NEGUS. April 14th.

9,225. "Starting and synchronising rotary converters." SIEMENS-SCHUCKERTWERKE G.M.B.H. April 14th. (Convention date, April 14th, 1913, Germany). (Complete).

9,231. "Current-collecting apparatus for electric dynamo machines." SOC. ANON. DES AUTOMOBILES ET CYCLES PEUGEOT. April 14th. (Convention date, April 16th, 1913, France). (Complete).

9,232. "Electrolytic apparatus." W. THUM. April 14th. (Complete).

9,237. "Manufacture of chemically-pure soluble silicic acid." GES. FUR ELEKTRO OSMOSE M.B.H. April 14th. (Convention date, April 14th, 1913, Germany). (Complete).

9,261. "Manufacture of stable colloidal solutions of metals." GES. FUR ELEKTRO OSMOSE M.B.H. April 14th. (Convention date, April 14th, 1913, Germany). (Complete).

9,265. "Diaphragm for electro-chemical or electro-osmotic purposes." GES. FUR ELEKTRO OSMOSE M.B.H. April 14tn. (Convention date, April 14th, 1913, Germany). (Complete).

9,278. "Magneto-electric machines for medical use." E. C. R. MARKS. April 14th. (Soc. Gallot et Cie, France). (Complete).

9,280. "Dynamo-electric machines." J. L. M. YARDLEY. April 14th. (Convention date, April 14th, 1913, United States). (Complete).

9,285. "Method of and connexions for tuning antennæ to a plurality of electric waves which are independent of one another." W. J. MELLERSH-JACKSON. April 14th. (Otto Scheller und C. Lorenz Akt. Ges., Germany). (Complete).

9,289. "Controlling switches for electrically-actuated lifts." G. DIRKS. April 14th. (Convention date, April 14th, 1913, Germany.) (Complete.)

9,291. "Manufacture of condensation products of phenol and substances containing methylene radical." L. V. REDMAN. April 14th. (Convention date, February 24th, 1914, United States). (Complete).

9,292. "Manufacture of phenolic condensation products." H. WADE. April 14th. (S. Karpen & Bros., United States). (Complete).

9,300. "Automatic electrical signalling between trains." A. BROWN. April 15th.

9,305. "Electric couplings of the plug-and-socket type and the like." J. W. ANNAND. April 15th.

9,331. "Method of and means for jointing telephone and other cables." L. J. ARON. April 15th.

9,351. "Non-magnetic compass." E. KLAHN. April 15th. (Convention date, May 12th, 1913, United States). (Complete).

9,367. "Methods of coating metals and apparatus therefor." BRITISH THOMSON-HOUSTON CO., LTD. April 15th. (General Electric Co., United States). (Complete).

9,376. "Printing-telegraph systems." WESTERN ELECTRIC CO., LTD. April 15th. (F. T. Woodward, Belgium). (Complete).

9,390. "Manufacture of condensation products from phenol or cresols and formaldehyde and the like." A. HEINEMANN. April 15th.

9,411. "Electric resistances." F. CELERI. April 16th. (Complete).

9,440. "Electric incandescence or glow lamps." A. GIORGI. April 16th.

9,451. "Methods of frequency transformation." BRITISH THOMSON-HOUSTON CO., LTD. April 16th. (General Electric Co., United States).

9,454. "Driving road and rail vehicles." THOMAS TRANSMISSION, LTD. and J. G. P. THOMAS. April 16th.

9,463. "Dynamo-electric machines applicable for the lighting and self-starting of motor road vehicles." R. W. DUNCAN and A. ICONOMUS, jun. April 16th.

9,464. "Electric motors." A. ICONOMUS, jun. April 16th.

9,468. "Attachment of electrical conductors to dynamo brushes and the like." SOC. ANON. LE CARBONE and E. GINDRE. April 16th. (Complete).

9,478. "Insulators for telegraph, telephone, and other similar wires." H. B. CORBIN AND SIMPLEX INSULATORS (Bourke's Patent), LTD. April 16th.

9,492. "Electric switches." W. M. ROLPH. April 16th. (Complete).

9,504. "Aural electric signal repeater." J. W. CLARKE. April 17th.

9,538. "Joints for electric cables." C. G. WATSON and CALLENDER'S CABLE AND CONSTRUCTION CO., LTD. April 17th.

9,539. "Joints on insulated electric conductors." C. G. WATSON and CALLENDER'S CABLE & CONSTRUCTION CO., LTD. April 17th.

9,542. "Devices for use in connection with motors for providing safety against firedamp or the like." MASCHINENFABRIK OERLIKON. April 17th. (Convention date, April 19th, 1913, Germany). (Complete).

9,558. "Electric switches." J. H. TUCKER and J. A. CRABTREE. April 17th.

9,570. "Alarm thermometers." G. EDELMANN. April 17th. (Addition to 20,342/12. Convention date, April 18th, 1913, Austria.) (Complete.)

9,578. "Dynamo-electric machines." BRITISH THOMSON-HOUSTON CO., LTD. and N. SHUTTLEWORTH. April 17th.

9,582. "Electric railway systems." K. E. STUART. April 17th. (Complete).

9,504. "Fuse and contact electrical fire alarm." A. G. PEMBERTON. April 18th. (Complete.

9,605. "Electrical apparatus in which an electric current is switched on by means of an independently-generated current." C. O. SILVERS. April 18th.

9,611. "Track circuits for railways." W. H. DAMMOND. April 18th. (Complete).

9,637. "Telephone transmitters." E. C. R. MARKS. April 18th. (Electrical Experimental Co., Inc., United States). (Complete).

9,638. "Telephone receivers." E. C. R. MARKS. April 18th. (Electrical Experimental Co., Inc., United States.) (Complete.)

9,648. "Telephone systems." AUTOMATIC TELEPHONE MANUFACTURING CO., LTD., A. B. SPERRY, and A. J. RAY. April 18th.

9,659. "Electric light shade carrier or holder." R. J. ESKRIGGE. April 18th.

9,666. "Synchronising systems." A. F. DICKSON. April 18th. (Complete.)

Ultraviolet Light and Bacteria.—By the action of ultraviolet radiation upon anthrax bacilli, Madame Victor Henri has effected profound changes in the appearance and behaviour of the bacteria; two new forms have been produced, one of which sets up an infection different from that of anthrax. The new forms were stable over 60 days and upwards. The experiments are considered to open up wide possibilities in the transformation of micro-organisms.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1913.

7,245. OVERHEAD LAMPS. H. Wade (Schneider & Naujoks Elektrizitats Ges.). 26th March.

7,544. AUTOMATIC REGULATORS FOR ELECTRIC SUPPLY SYSTEMS. C. F. Kettering. March 31st. (August 9th, 1912.)

7,546. AUTOMATIC REGULATORS FOR ELECTRICAL SUPPLY SYSTEMS. C. F. Kettering. March 31st. (November 11th, 1912).

7,586. ILLUMINATED SIGNS SUITABLE FOR ADVERTISING AND OTHER PURPOSES. T. Jacob and E. W. White. March 31st.

7,638. ELECTRIC BELLS OR GONGS. F. F. Macdonald. April 1st.

7,840. ELECTRICAL DYNAMO MACHINES. J. Peugeot. April 3rd.

7,842. DRIVING OF LOOMS BY ELECTRIC MOTORS. Siemens Schuckertwerke Ges. April 3rd. (April 3rd, 1912).

8,054. SHIPS' SIGNALLING OR TELEGRAPH APPARATUS. J. S. Commander. April 5th.

8,115. LUMINOUS ELECTROLYTIC DEVICES. L. H. Walter. April 7th.

8,124. INCANDESCENT ELECTRIC LAMPS. E. P. Beckwith. April 7th.

8,128. DYNAMOS. C. T. Mason. April 7th. (April 23rd, 1912).

8,172. MERCURY VAPOUR LAMPS. W. A. A. Steinmann. April 7th. (April 12th, 1912).

8,416. ELECTRIC ARC LAMPS. British Thomson-Houston Co. (General Electric Co.). April 9th.

9,321. LIGHTING OF MINERS' AND LIKE SAFETY LAMPS. A. Paxton. April 21st. (Patent of Addition not granted).

9,460. ELECTRICAL CONNECTORS OF THE PLUG AND SOCKET TYPE. A. P. Lundberg, G. C. Lundberg, P. A. Lundberg and G. Pegg. April 22nd.

9,503. AMPERE-HOUR METER. Allgemeine Elektricitats Ges. April 22nd. (April 24th, 1912).

13,019. MECHANICAL AND ELECTRICAL DEVICE FOR STARTING AND STOPPING A STOP WATCH PRIMARILY INTENDED FOR TIMING MOTOR-CYCLE AND MOTOR-CAR RACING, BUT APPLICABLE TO ALL OTHER FORMS OF RACING. H. R. Haigh. June 5th.

13,063. ELECTRICALLY-HEATED FLAT IRON. F. S. Rippingille. June 5th.

13,148. CONTROLLING OF ELECTRIC MOTORS FOR SHIP PROPULSION AND MEANS THEREFOR. Siemens Schuckertwerke Ges. June 6th. (Addition to 2,136/13).

13,721. ELECTRIC SWITCHES. O. Lucas and F. Handley. June 13th.

14,034. APPARATUS FOR CLOSING AND INTERRUPTING ELECTRIC CURRENTS. V Poulsen. June 17th.

14,170. ELECTRIC LIGHT FITTINGS OF THE INDIRECT KIND. O. D. Lucas and Veritys, Ltd. June 19th.

14,941. COOLING OF DYNAMO-ELECTRIC MACHINERY. Akt. Ges. Brown, Boveri et Cie. June 28th. (February 24th, 1913).

15,318. ELECTRIC LAMP-HOLDERS OR SIMILAR COUPLING MEMBERS. G. St. J. Day. July 3rd.

16,885. ELECTRIC SWITCHES. H. Lucas and O. Lucas. July 23rd.

17,532. ELECTRIC CIRCUIT CLOSING DEVICES. Siemens Schuckertwerke Ges. July 30th. (August 16th, 1912).

17,954. LANTERNS FOR ELECTRIC FILAMENT LAMPS. A. G. Bloxam. (Robert Bosch, Firm of). August 6th.

18,801. RAILWAY SIGNALS. J. D. Taylor. August 19th. (August 28th, 1912).

18,924. SPARKING PLUGS WITH AN INSULATOR COMPOSED OF TWO PARTS. Siemens & Halske Akt. Ges. August 20th. (October 25th, 1912).

20,028. ELECTRIC BURGLAR ALARMS. A. Renczewitz. September 4th.

20,870. MEANS FOR OPERATING ELECTRIC SWITCHES FROM A DISTANCE. Siemens Bros. Dynamo Works, Ltd., F. Lydall and R. Brooks. September 16th.

23,004. APPARATUS FOR ELECTRICALLY SMELTING METAL, METAL ORES, AND THE LIKE. S. Guggenheim. October 11th.

24,944. ELECTRIC POCKET-LAMPS. G. Hitzelberger and The New British Ever-Ready Co. November 1st.

25,176. GRAPNELS FOR RAISING SUBMARINE CABLES. C. A. O. Berner and H. W. T. De Lisle. November 4th.

25,274. ELECTRICAL PROTECTIVE SYSTEMS. E. G. Waters. November 5th. (Addition to 26,961/12).

25,464. COLLECTOR BRUSH-HOLDERS FOR ELECTRICAL APPARATUS. W. Christie. (Galvanische Metall-Papier Fabrik Akt. Ges.). November 7th.

27,824. RELAY ARRANGEMENTS FOR THE AUTOMATIC CONTROL OF ELECTRIC CIRCUITS OR APPARATUS. Siemens-Schuckertwerke Ges. December 3rd. (December 4th, 1912).

29,028. METHOD OF COVERING OR ARMOURING ELECTRIC CONDUCTORS WITH METAL. F. Chase. December 16th.

1914.

2,815. DEVICES FOR OBTAINING RONTGEN-RAY IMAGES. G. Bucky. February 3rd. (February 5th, 1913).

3,305. STAGE ILLUSIONS. L. McCormick. February 7th.

5,365. COMMUTATORS FOR ELECTRICITY METERS. J. Elster. March 2nd. (Divided Application on 5,157/13. February 28th).

6,055. ELECTRODES. Fried Drupp Akt. Ges. March 10th. (April 15th, 1913).

Fatality.—An inquiry into the cause of death of John William Burton, 48, a Middlesbrough electrician, was held by the City Coroner, Mr. Appleby, at Newcastle-on-Tyne Infirmary, on April 23rd. Mrs. Burton, the widow, stated that on October 24th, 1912, her husband was working on an overhead electric crane when he was thrown against the window, in consequence, he thought of having received a shock. His right ear was cut. His injuries were attended to, but in February of the following year he complained of pains in the head. He was medically treated but got worse and was removed to the Newcastle-on-Tyne Infirmary in December, where he died on April 22nd. Dr. Pirrie said death was due to a tumour on the brain, but he did not think the accident had caused it. A verdict that death was due to a tumour on the brain was returned.

Radium.—A Committee representing the hospitals in the Manchester district is raising a fund to purchase at least £25,000 worth of radium, to be placed in the charge of a physicist and an expert medical radiologist. A number of gentlemen are arranging for the purchase of £1,500 worth of radium for presentation to the Swansea Hospital.